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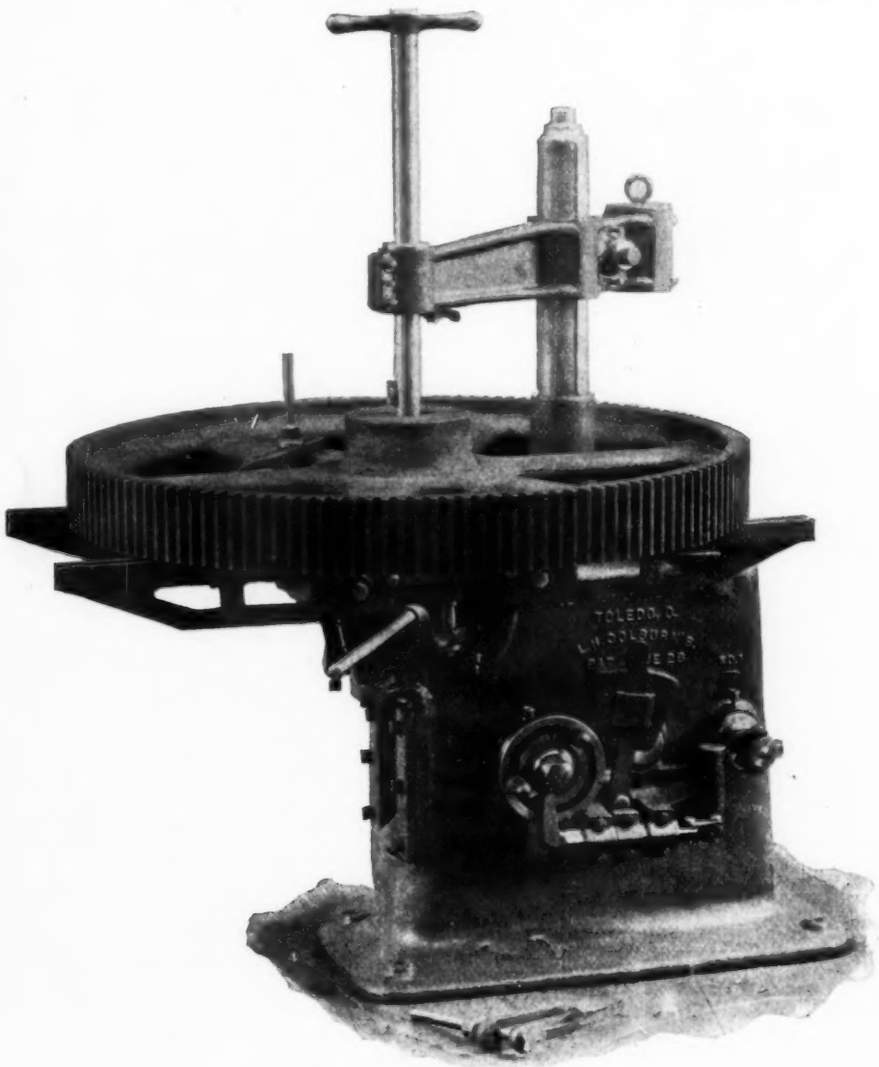
Improved Key-Seater.

By the engraving on this page we illustrate an improved form of the Colburn machine for cutting keyways.

The machine as now made has a platen which is pivoted at the back and is adjusted for tapers by the set screws shown in front, just below the feed lever, a graduated scale and pointer showing the taper per foot.



IMPROVED KEY-SEATER.

The engraving shows the machine with bars attached to each side of the platen, by which means the occasional large job which comes to such a machine is readily done; and to facilitate such work the post or standard on top is provided with two points of attachment to the machine, so that if it interferes with the work when in one position it may not do so in another. The post is also now made relatively higher than before; so that when a large hub is recessed, or a double-armed and hubbed pulley is to be operated upon, it can readily be done in two operations, the graduated dials and stops insuring the exact proper relation between the two parts of the work—which by this means may be 18 inches long, though the stroke of the machine is only 12 inches.

The gearing is now entirely inclosed within the frame, and chips are discharged by a suitable channel in front.

The machine is made by Baker Bros., Toledo, O.

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Keying Wheels on Shafts—Fighting Prejudices—Revolving Ropes.

BY W. H. BOOTH.

During my lifetime I have experienced a deal of trouble with wheels and other things keyed on shafts. The idea of the whole thing is, of course, to bore the wheel to fit the shaft and then make secure with the key. On railways they push the wheel upon the shaft by enormous pressure, and on one line they do, or they did, dispense with keys altogether as unnecessary and a source of weakness, the grip of the wheel being held sufficient in itself for all purposes.

But we do not all have a railway shop to play with, and the cases which come to my mind are the backwoods sort of places, where you want to get a wheel loose. You work half a day in getting out the key, and the wheel is apparently just as fast as it was before. If it happens to be a bent crank shaft, how are you going to get that wheel off? You cannot drive it off; because, if you do, you are certain to distort the shaft, or injure the crank-pin portion, and you are reduced to scraping the shaft or draw-filing it, and at last in various ways you get the wheel free, and there is nearly as much trouble getting on the new wheel. You make a gage and send it to the wheel foundry, and the wheel turns up in due season about the thousandth of an inch tight, and there is more filing; or it comes too big—and the tendency is to get it bored too big—and your erector calls it a nice fit because it slides into place easily, and he keys it up and goes home, thinking he has done a good, honest job; and after all what has he effected? He has got a small circle inside one a bit larger, and has driven a steel wedge between them; and if he would spend one minute in thought, he would realize that the two circles are simply in contact along a line, and all the hold between shaft and wheel is on two opposite sides—this same line and the key. It is

all very well to say that by careful gaging and machining you can get a fit. You cannot do so with machine tools unless you finish by grinding. A piece of shaft 6 inches long, which is a driving fit in a bored hole, is distinctly of a different diameter, and the key will bring out this difference when it is driven up; so that the idea of a good fit in ordinary mill work is a fallacy.

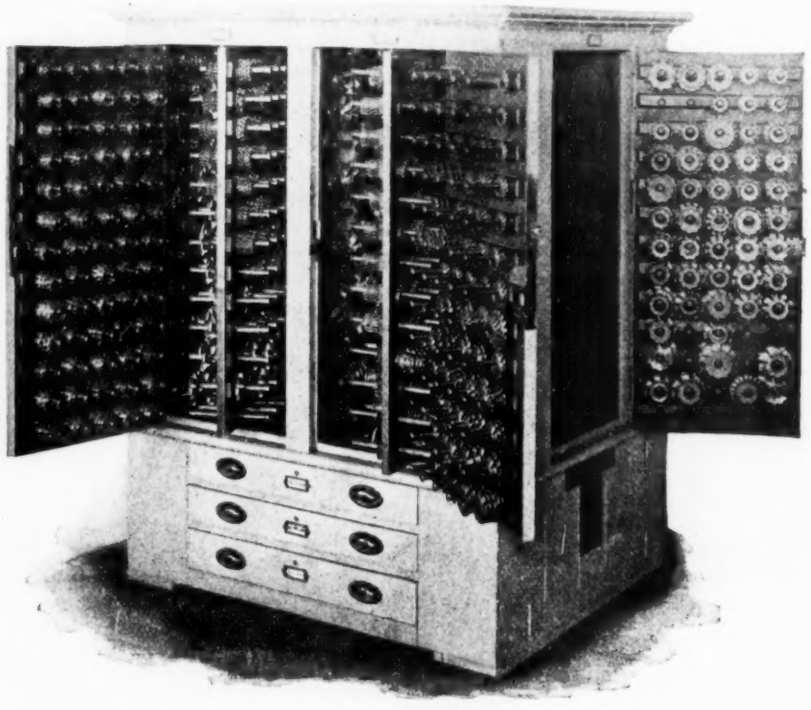
Even when you have your supposed fits, there is the trouble when repairs and renewals come to be done—there are the strained cranks, the battered shaft ends, the time wasted and the losses due to such wasted time. It chanced some years ago that I fell across a descriptive catalog of the Porter-Allen engine, in which was described the crescenting device recently described by Mr. Porter in the "American Machinist," April 23d. Since that time, where I have been able, I have followed the system he describes. I order a shaft turned exactly to 4 inches, and I order a wheel bored exactly 4 inches, and then crescented out, say, $\frac{1}{32}$. I know that it is easier to get a thing done exactly to 4 inches than it is to get it $4\ \frac{1}{1000}$ inches. There is no trouble with making gages; and where your crank shaft is made in the Eastern counties, and your wheel in the West, the matter is simplicity itself. You order the keyways cut to your standard width, and simply assemble the parts and fit your key, and you know you can rattle the wheel off as soon as you get the key out. You know also that you have got the wheel fitting on nearly half a circle on the shaft, and if you follow the plan for any length of time you will find it will pay. There are a goodly number of such fits now running on pumps up and down this country, and the wheels don't have teeth more than half a pitch long.

In following out the above practices, I have met with nothing but dogged, obstinate obstruction and resistance. Though I knew the keying system had worked perfectly in the Porter-Allen engine, I was told that it would fail in my slow-running old pumps, and I can sympathize with Mr. Porter in his experiences. I have had exactly the same stupid obstinacy to contend with in all I have done in the way of short wheel teeth—and this, too, after they had long shown themselves perfectly satisfactory. But no; they were wrong at any price, except with those who had to pay for them. They, I am happy to say, have always accepted them, probably because they have objections to the numerous breakages entailed by longer teeth. Mechanics who ought to have known better have been as stupid as they knew how to be—professed to be unable to see how driving up the key could bring the wheel exactly to place. In one case only have I had a failure, and that was clearly due to an error of the machine man, who bored out the hole to full size in place of crescenting it.

I entirely fail to understand why so much opposition should be shown; but it is simply stating a plain fact that I have met with such opposition, and exactly the same kind of fatuous objecting has run amuck against my endeavors on the wheel-tooth question. It is a sort of thing of which one tires in time. You do your best to put things on a footing of excellence, combined with cheap production and easy erection; and where you are not the owner of a whole shopful of tools, but have to rely on outside shops, and are practically in the position of having your various lathes and boring mills separated by hundreds of miles, some system must be adopted which will put a stop to the everlasting filing and scraping, and yet which will secure good results. Well, you try to carry out this system, and no one does a willing turn to help you. The only satisfaction I have myself had out of the matter is that of knowing that my work is sound, and that it will cost less in repairs than the work which comes before and after it, and cause much less annoyance. The forced fit is the correct one where the proper press will always be available to deal with it; but for general work it is, in my opinion, impossible to improve on Mr. Porter's plan.

I have not the number before me, but in a recent copy of the "American Machinist" someone asks me a question about ropes revolving on their axes instead of bedding themselves in their grooves. I can find no one who can satisfactorily explain this. For myself, I have thought it to be due to the want of exact oppositeness of the driving and driven grooves; but am assured that such is not the case; and, indeed, I have seen a pair of pulleys on which, by an error, the pitch of the grooves was different in the two rims, and there was no revolution of the ropes except in one case. Some attribute the fault to error in putting on or in splicing; but just what faults can be committed then that will not cure themselves after a few minutes running, I cannot see. Others will tell you that the fault is simply fortuitous, and that a rope simply begins to revolve when new, and goes on doing so, never being able to get itself into shape.

But a more probable cause is the shape of the groove. A groove ought to have straight sides, but they are sometimes purposely made curved, and I believe that the curved sides are some hindrance to the bedding of the ropes. The objection to the revolving is simply that the rope is exposed to a constantly changing pressure—first in one direction, then in another. It is kneaded, in a sense, into a pulp, instead of becoming consolidated, and it is exposed to more severe bending actions, the bending being now reversed in place of being always in one direction. The interior of the rope is exposed to a double stress in this way—that of extra bending, and that of kneading. Further, when a rope beds itself, it takes on a roughly triangular form, and the two sides which bed in the groove become covered with a hard glaze, compounded of dust and of the dressing compound, which should be used, in very small amounts only, to lay the fluffy surface. This glaze protects the rope; but in a revolving rope it cannot form, for it is destroyed by the kneading



CUTTER CUPBOARD.

action, and altogether there are, from all points of view, good and satisfactory reasons to avoid rolling.

London, Eng.

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Cupboard for Milling Cutters.

Where milling machines are much used, cutters ought, and usually do, accumulate pretty fast, and it is important to keep them classified and in such shape that any cutter wanted for use can be quickly obtained.

We give on opposite page engraving of a cupboard for this purpose, used in the shops of the Brown & Sharpe Mfg. Co. It is 5 feet 5 inches high, and at the time the photograph was taken contained 2,859 cutters.

IMPROVED ROLLER BEARING.

A New Roller Bearing.

The accompanying half-tone will serve with little explanation to show a recently improved form of roller bearing. The illustration shows a pillow block with the cap removed, thus showing the essential features of the present construction. It will be seen that provision is made for taking up wear or for renewal, without change or injury to the main casting. The bearing is, of course, equally applicable in all places and under all conditions where roller bearings are suitable. The rollers are held in relative position by sections of a ring, instead of by a continuous ring, as has been customary. The bearing sleeve in which the rollers revolve is also made in sections, usually three, which have between their ends little slips of metal, which may be removed one at a time as the rollers or the bearing surfaces wear and it is desirable to take up the slack of the bearing. When the slips are removed, the cap is tightened again. If the roller track is absolutely round at the beginning, it, of course, cannot remain so after the successive take-ups, but the variation from rotundity is very minute, and the slack must be certainly less than if no take-up was provided.

The inventor of the bearing is W. J. Tripp, M. D., 359 Lenox avenue, New York City.

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The Bicycle Pedal-Pin.

BY SAMUEL W. BALCH.

Should the bicycle pedal-pin or axle be screwed into its crank right or left-hand? The present practice of bicycle makers gives no decisive answer to this question. Some thread the right pedal-pin left-hand, and the left pedal-pin right-hand; others, on the contrary, make the hand of the thread the same as the side on which it is to be used.

These two exactly opposite methods of construction result from two antagonistic theories. The first of these, which I shall call the "friction theory," requires that the right pedal-pin, for example, should be threaded left-hand; and the second of these, which I shall call the "wabble theory," requires that the right pedal-pin be threaded right-hand.

THE FRICTION THEORY.

Every tyro who has ever greased a wagon knows that the nuts which screw on the ends of the axles to hold the wheels are not the same on both sides; and if he has an inquiring turn of mind, he is not long in finding out the reason. The nuts are threaded left-hand on the left side and right-hand on the right side, so that the friction of the wheels against the nuts, when the wagon is going forward, will tend to screw them on and not off. This is sound theory, and long experience has proved it to be equally sound practice.

It has been natural, therefore, that cycle makers should jump at the conclusion that the theory applies as correctly to vehicles with two wheels as to vehicles with four, and to pedal-pins screwing into their cranks as well as to the nuts on the axles of wagons. In re-applying the theory it is, however, necessary to observe that there is a reversal of motion. The pedal does not revolve as does the wagon wheel on the corresponding side, but is held stationary by the foot while the pin within the pedal is carried around in a forward direction. This is the mechanical equivalent of a backward revolution of the pedal, as anyone can readily see who has a bicycle at hand.

Whatever conditions are found to apply to the right crank will be reversed on the opposite side and the discussion will therefore, for convenience of statement, be confined hereafter to the crank and pedal-pin for the right foot.

Assuming now, as all makers of wagons and most if not all the early makers of cycles assumed (and many continue to assume), that the friction theory is the one to follow, it will be seen that, while a right-hand thread is correct for a wagon axle, a left-hand thread should be used on the bicycle pedal-pin.

THE WABBLE THEORY.

It has been the experience of many riders that the pins of their pedals will work loose unless firmly held by check-nuts, although they are correctly threaded according to the friction theory, as above described. This is a state of facts that has demanded inquiry, and has resulted in the discovery by Mr. C. S. Burnham, of Yonkers, N. Y., of a principle in the mechanics of the bicycle crank and pedal that bicycle manufacturers have failed to recognize. It is—that a contrary revolution to that which the friction of the bearings would produce, arises from the wabbling of the pin in the crank-eye.

For this wabbling to take place it is

Fig. 1
Crank eye with Pedal-pin in section.

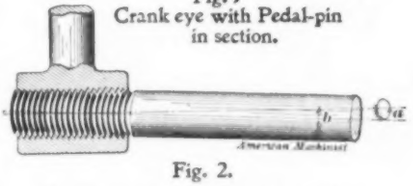

Fig. 2.
Perspective view showing why the pedal-pin unscrews.

necessary that the pedal-pin in the eye be smaller than the eye, so that the axis of the pin under the pressure of the foot will be deflected to an angle with the axis of the hole in the crank-eye. This will bring the pin to the lower side of the eye at the outer side of the crank, as shown in Fig. 1, and at the upper side of the eye at the inner side of the crank. As the crank

revolves the pin will be pushed around or will wabble in the eye. This analyzes into a double rotation of the pedal-pin with reference to the crank—first, of the axis in the direction shown by the arrow *a*; and second, of the pin on its axis in the direction of the arrow *b*. It is this second rotation that must be considered in determining which way the pin should be threaded so as to work tight instead of loose with use. For the right pedal-pin the thread should be right-hand, and for the left pedal-pin left-hand. If it is threaded in the opposite direction, as shown in Fig. 2, it will unscrew.

This contrary revolution of the pedal-pin due to its wabbling can be illustrated with a lead pencil, the point of which is carried around in a small circle with the forefinger of one hand, while the opposite end of the pencil is supported in the neck of a bottle, or held loosely in the fingers of the other hand.

THE TWO THEORIES COMPARED.

Of these two theories the one that will dominate, and that should therefore be considered in determining the direction of the thread, will depend on certain conditions. For the friction theory to apply it is necessary that the friction between the pedal and its pin should be greater than the friction of the pin in the crank-eye. This means that the ball-bearings must work harder and stick tighter than the thread of the pin in the crank-eye. This is a condition that evidently cannot readily occur with most designs of pedals. I have had it occur once with one pedal of my own wheel. The pedal construction in it is somewhat peculiar. It combines in one piece the check-nut and inner cone of the pedal. The cone was set up tight so that the balls were clamped, and the friction was thus made sufficient to turn the pin. This it immediately proceeded to do. The consequence was that the pedal was frozen fast in a moment, and the wheel had to be propelled with one foot till a repair shop could be reached and tools heavy enough to unscrew the pin obtained. The wabble theory requires that the pin be smaller than the hole in the crank-eye into which it screws. It, of course, need not be as small in proportion as is shown in the picture; and, in fact, the difference in diameter may be extremely slight and not sensible to measurement. As a striking illustration of this, my attention was called to an instance in which the pedal-pin had wabbled in so tightly that a machinist was not able to unscrew the crank, with the pin held in a vise, until the eye had been expanded by heating.

In order to ascertain the practice of various makers, I called at the New York agencies of several of the leading makers of cycles, examined their exhibition wheels, and asked the salesman in charge whether the pedals ever came loose. The salesmen, with one exception, answered me that the pedals on their makes of wheels did not work loose, and were all confident that their wheels were put up as they should be. From the wheels themselves, I was, however, able to glean a more candid disclosure of the facts for the existence of check-nuts on all the machines designed on the friction theory, and their omission from all those designed on the wabble theory, was to my mind the most convincing testimony in favor of the latter. Furthermore, the agents whose wheels were set up on this latter plan were prepared to answer me not only that the pedal-pins of their wheels were threaded correctly, but that if threaded the other way they would work loose instead of tight.

The exception above noted was at the agency of a wheel which uses right-hand threads on both sides. The right side was therefore threaded in accordance with the wabble theory, and the left in accordance with the friction theory. He said that the left pedal was more liable to work loose than the right, but claimed that if properly tightened it would give no trouble; and urged the advantages of having both sides alike so that orders for parts could be filled without delay, when, as was generally the case, the order failed to state on which side the pin was to be used.

It was my intention when I commenced this article to merely state both sides without giving preference to either, but the evidence has been so overwhelming as to force my aceptance of the wabble theory as the one of real effect. But I do not wish to prejudice any one against purchasing wheels that are set up on the friction theory, for it is merely necessary to change the cranks to the opposite sides if the pedals show any tendency to come loose. The uncertainty as to the side which has the left thread is at present a source of some annoyance; for one does not wish when contending with a tight thread to make a mistake, and by applying force in the wrong direction make the joint tighter. Makers would do well to prevent this by stamping on the cranks the words "left thread" or "right thread," as the case may be.

In conclusion, it is worth while to point a moral on the danger of following theories and remaining blind to facts that contradict them, and the necessity of constantly keeping a watchful eye for what is true as much as for what we expect to be true. Bicycle manufacturers, by doing this, could have saved themselves and wheelmen untold annoyance with loose pedals.

Yonkers, N. Y.

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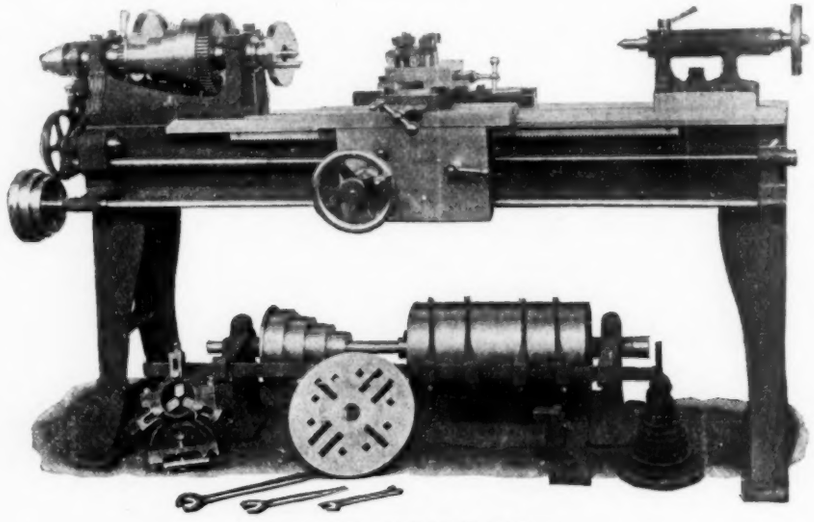
An Anglo-American Lathe.

We give herewith an engraving of a lathe built in Coventry, England, by Alfred Herbert.

Its point will be readily understood from the engraving, together with the inscription written across the top of the photograph by Mr. Herbert, which inscription is as follows:



AN ANGLO-AMERICAN LATHE.

"Thirteen-inch swing engine lathe—American in general design, but with compound rest and tool-holder, and with extra stiffness of detail, to suit our clumsy requirements over here."

That is all he says about the lathe; the photo tells the rest.

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Judge Reeve, Solicitor of the Treasury, has rendered an opinion to the effect that a patented design is not a trade-mark within the meaning of the Act of August 28, 1894, and therefore is not entitled to registration in the Treasury Department.

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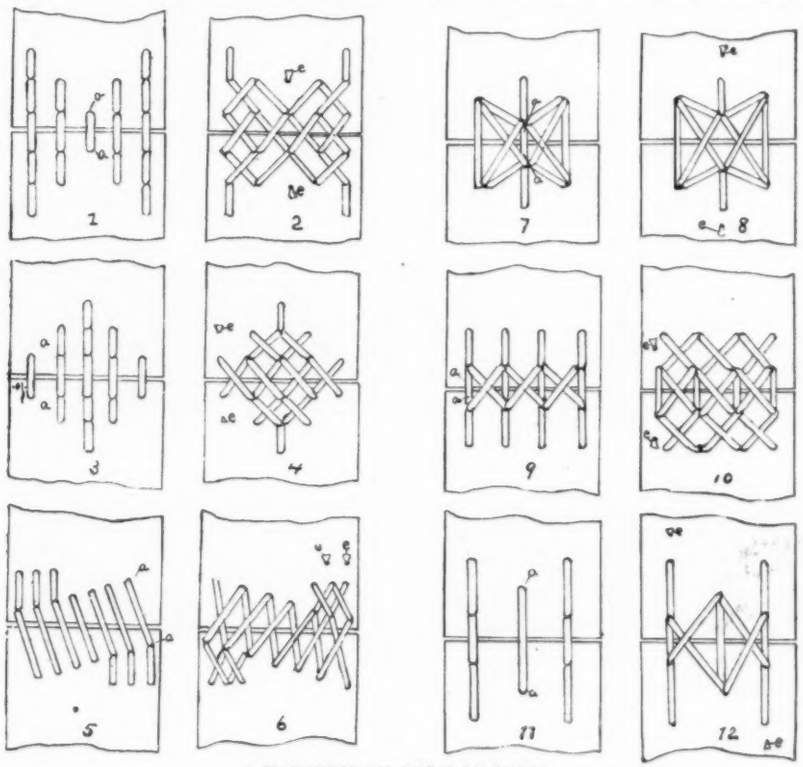
The Diamond Machine Co., of Providence, R. I., have shipped a large order of grinding machinery to the Japanese Government. The order was received through their London agent, and includes, besides other things, ten large-size water tool grinders.

Odd Belt Lacings.

BY B. F. FELLS.

Herewith are some drawings of belt lacings from samples furnished by engineers. There is quite a contrast in the amount of lacing material used, yet each system is claimed to be efficient by its maker.

The belt lacing Nos. 1 and 2 is certainly strong enough. For making this union, about all the instruction that the ordinary man needs is that the holes be punched even, uniform, and that elastic lacing be used, the straight laces being run against the face of the pulleys. No. 1 is the front of this union, and No. 2 the back. The starting point for the lace is at *a a*, and



A VARIETY OF BELT LACINGS.

the sewing can be worked toward either side, coming back by crossing on the back, and going to the opposite side to return to the center again, where the union is completed and the ends of the lace brought out at *e e*.

Nos. 3 and 4 appear to be a substantial lacing for light work and general purposes, and easily and quickly made. The lacing can be readily done by commencing at *a a* in No. 3, and working to the opposite side in the manner shown on the back of No. 4, finishing at *e e*.

Lacing No. 5 is quite odd. It is claimed that this will hold longer on quarter turns than some other kinds. It is made by beginning at *a a* with both ends of the lace, and lacing toward the other side, as indicated on the back of No. 6, ending at *e e*.

No. 7 comes from a saw-mill man. It is loose and easily made, and adaptable for ordinary work. When belts that have considerable work to do are laced on this principle, a double sewing or extra strong lacing is required. Scratch two lines across each butt, about half an inch apart, and the inner line same distance from the edge of the butt. Then punch the holes at stated distances, and draw in the laces according to the diagram, beginning at *a a* and finishing at *e e*, No. 8, which is the back, on which the laces are crossed as on the face, owing to the double-lacing system.

The maker of lacing Nos. 9 and 10 aims to distribute the strain of the lacings over as wide a surface as possible. To lace this, use a reliable lace and insert an end into holes *a a*, drawing the lacing through so that each end will be of the same length; then one of the ends of the lace down through the hole in front of last, up through opposite hole and down through next hole beyond that, thus working the lace into the series of holes straight through, winding up at *e e*. Be sure the laps do not ride; do not draw the laces as tightly as you can; be careful not to get the laces twisted anywhere.

A millwright sends in the sample Nos. 11 and 12. It is made by starting at *a a* in No. 11, and at *e e* in No. 12, which is the other side.

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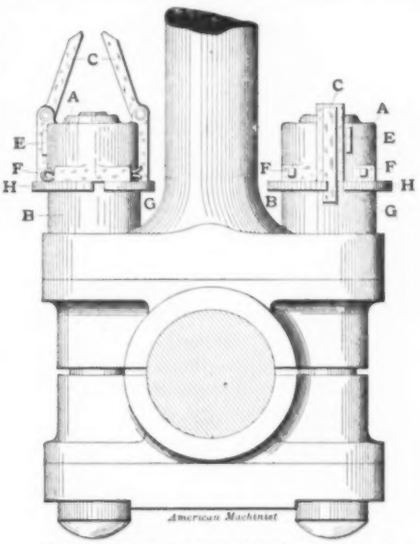
The Automatic Adjustment of Connecting-Rod Boxes.

We find in the "Mechanical World," London, the cut which we reproduce of a device for automatically taking up the wear of crank-pin brasses. We, of course, cannot speak of its success or value in practice; but its ingenuity should commend it to the attention of mechanics. It is certainly an effective, though rather elaborate, lock-nut, if nothing more. The following description of the device is given:

"It consists of a round nut *B*, provided with a collar *H* and a separate brass cap



AUTOMATIC ADJUSTMENT OF ROD BRASSES.

A, inside of which is a coiled spring, one end *E* of which projects through the cap, as shown, while the other end is suitable for passing through a saw cut in the reduced end of the bolt inside *A*. Part of the nut *B*, which is reduced slightly in diameter, projects inside the cap, and has a groove all round it. Split pins *F*, passed through holes in the cap, engage with this groove, thus fastening the nut and cap together, while allowing them to revolve independently of each other. The nuts can thus be screwed on or off the bolts as ordinary nuts. The method of procedure is as follows: The cap is held so that the end of the spring inside the cap comes fair with the saw cut in the bolt, the hinged pawls *C C* being raised as shown in the left-hand view, and the nut *B* screwed on. The cap *A* will not turn round, but will follow the nut along the bolt. After the nut is up, the cap is given a turn in the opposite direction to that in which the nut was screwed, thus putting the spring in tension. The pawls *C C* are now dropped into the notches *G* in the collar of the nut, as shown, thus completing the operation. Any wear of the brasses is now compensated by the nuts, which automatically rotate under the tension of the spring, thus maintaining the brasses in constant adjustment.

"The claims made for this device are that it saves the time spent in stripping worn brasses, insures the silent running of the parts fitted with these nuts; causes the brasses to wear longer, while reducing to a minimum the initial pressure on the crank pin."

ELECTRICAL MACHINERY.

Building of a Great Dynamo—VI.

The armature star, center magnet piece with the radial magnets bolted to it, and the brush star, make up the principal pieces of machine shop work in a large dynamo. The armature shaft on which the armature runs is now generally an integral part of the engine shaft, that member being simply made long enough to take the armature. For a long time it was thought needful to make the engine shaft in one piece and the dynamo shaft in another piece, and couple the two together where the dynamo was direct-driven. Why this very expensive coupling was introduced can hardly be told; it was thought better engineering to make the shaft in two pieces, and it was so made, and is still so made in some cases, although it is perhaps the prevailing practice to make single-piece shafts for direct dynamo driving at the present time. The engraving of this dynamo at work, Fig. 26, shows how perfectly easy it is to combine the steam engine and dynamo shaft; and certainly no engineer would choose to introduce so expensive and difficult a construction as a shaft coupling to transmit 1,500 horse-power without it was a necessity. A shaft coupling of such size is a big piece, and it takes extremely good work to make it a true substantial job.

Figs. 24 and 25 are views on each side of the north and south machine-shop floor of the Siemens-Halske shops, looking south. The brush-holding star, or brush holder, of the big dynamo is shown in the foreground of Fig. 24, complete, laid on horses so that the brush holder rods clear the floor. Several center sleeves of this brush-holding star are shown in the right foreground; and just beyond, a star is shown with its hubs mounted on a turntable, having the brush holder rod holes drilled and reamed under an upright driller. The star is put up on the turntable so as to turn from one arm hub to the next without moving otherwise. Another brush star lies on the floor in the middle left, and just beyond it are a lot of radial magnets piled up, and a lot of magnet caps are piled up to the right of the radial magnets, and beyond them is a planer planing magnet caps. The brush-holder star is a grey-iron casting, finished on the boring mill and under the drill press, and is so arranged in the assembled machine that it can be turned a short distance in either direction in order to bring the brushes carried on the twelve arms exactly in the neutral line between the fields, and it carries on its hub another star which has connecting rods leading to rocker arms on each of the brush-holder rods. The brush-holder rods are all mounted to turn in the hubs at the ends of the star arms, and by turning the lifting star mounted on the hub of the brush star, all of the brushes are lifted off the armature commutator bars at the same time. The brushes take the current, generated by revolving the armature, from the commutator bars, and transmit it to copper conductors mounted on the outside of the star arms, and these conductors finally deliver it to the cables which carry the current to the point of distribution to the trolley lines—Fig. 26 being from a Yerkes surface-road power plant at Fulton and Union streets, Chicago, put down by the Garden City Construction Company; the engines by Fraser & Chalmers, Chicago, and the dynamo by the Siemens-Halske Company. The brush star carries a number of details of

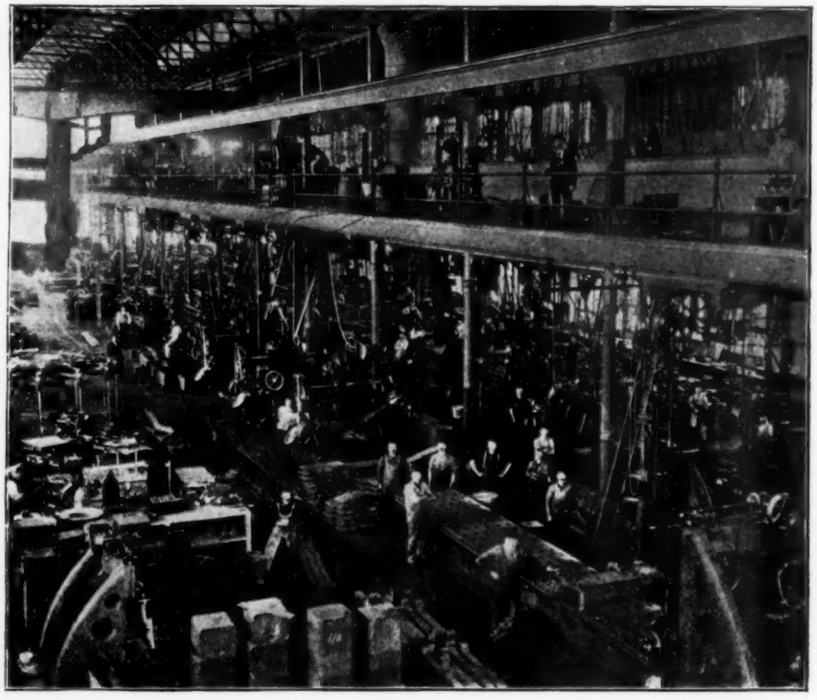


Fig. 25. WEST SIDE NORTH FLOOR.

Fig. 24. BRUSH-HOLDER STAR AND MACHINE SHOP.

interest, each of which might have well furnished a subject for illustration and description if these papers dealt with the operation of the dynamo. Dealing exclusively with construction, however, these features are simply examples of ordinary machine and copper and wire work, and hence do not call for detail notice.

Fig. 25 shows a lot of radial magnets in front at the left, and some locomotive frames in the middle, as the Siemens-Halske Co. finished up a lot of locomotives partly built when the Grant Works stopped.

H. L. A.

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The Electric Motor in Rolling-Mills and Steel Works.

Had anyone predicted ten or even five years ago that one of the most appropriate and useful fields of work for the electric motor would be found in rolling mills, the idea would not have been thought worth refuting. With the then supposed delicacy of electrical machinery of all kinds, and the supposed necessity for favorable surroundings and skilled attendance, such applications would not have been considered feasible. Rolling-mill work is of the most rugged character, and most of the attendants are more accustomed to the use of the sledge hammer than "scientific apparatus;" and with the view of electrical machinery formerly held the conditions are about as unfavorable as could be imagined.

The fact is, however, that this view of electrical machinery, as now made, is erroneous. Electrical distribution of power has already found extensive application in rolling mills, growing out of the fact that in reality the conditions of rolling-mill work are particularly well adapted to the system. In such mills the situation comprises several acres of ground more or less covered with detached buildings or sheds, in each of which some one operation is carried on. The quantity of material to be handled is of course very great, while, after the rolling is done, the work remaining on each piece is small. Conveyors are necessary to carry the material from building to building, and in each building will be located the machines for doing some one operation. In addition to this, cranes are necessary everywhere. Cranes form a field which the electric motor has marked for its own—to such an extent, in fact, that the electrical system has given a great impetus to crane construction. Cranes are now used in number and locations which would not be contemplated with any other system of operating.

The rolling mill of to-day has its stock and shipping yard covered with a system of electric cranes. Parallel overhead girders are erected on suitable posts, while from girder to girder are stretched the cranes. One end of each crane runway covers a point of delivery of the mill, while the other covers the shipping tracks. Between the two are the stock piles. The cranes pile up the stock as made, and deliver it to the cars as sold. The structures and cranes are exposed to the weather, except for a slight dog-house carried by the crane for the protection of the machinery and the operator. The runways are made of any length required, and the result is the handling of larger quantities of stock than would be otherwise possible, and with a crew consisting usually of three men per crane. One mill recently visited had nineteen such yard cranes in service.

Outside of the yard cranes, the work to which electricity is being applied in rolling-mill work is mainly in fields in which steam and hydraulic pressure have been heretofore relied on. No stronger testimony to the success of electricity in these fields could be brought forward than the fact that it is in places disputing the field with what has been heretofore the rolling-mill engineer's chief agent—hydraulic pressure.

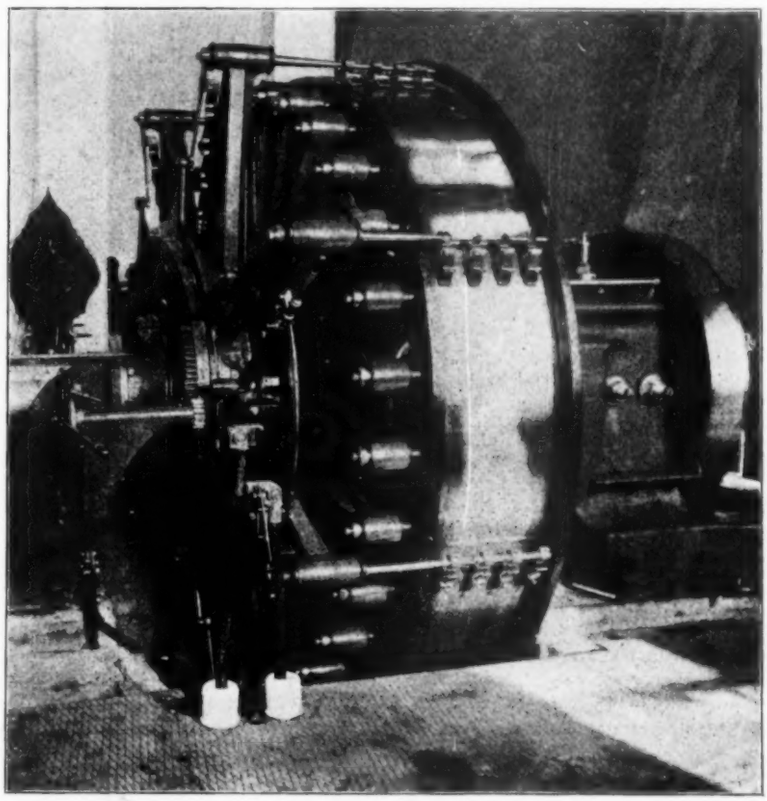

Fig. 26. THE COMPLETED DYNAMO.

The description of rolling-mill work above will have shown the necessity for having power of some sort available almost everywhere. Formerly this was obtained by a network of steam and hydraulic pipes. With the former, particularly, there is endless trouble due to expansion and contraction, with occasional wreckage of engines from the condensed water, as well as freezing up in cold weather, unless expensive provision is made to prevent it, and constant watchfulness exercised as well. Some of the applications of electricity noted in a recent trip through some of the largest steel mills of Pennsylvania were the following:

Feed tables for the rolls. These tables, as applied to three high mills, are required to be reversed in direction as the bloom goes back and forth, as well as be elevated and depressed at each pass through the mill. They have also to be adjusted laterally to deliver the bloom to the proper pass through the rolls, and likewise have to travel laterally to serve two sets of rolls placed alongside. A feed table is put up each side of the rolls. One delivers the bloom to the lower rolls, from which the second receives it, then immediately elevates it and passes it back to the first table through the upper rolls. This process continues until the stock is reduced to the final shape, when it is passed on to the hot saw to have its ends cut off. In one case the feed tables belonged to a mill for making 20-inch beams, and the entire handling of the stock from bloom to beam was done by two men—one at each feed table. In the case of the feed tables here described, tradition had led to the retention of hydraulic pressure for raising and lowering the tables, but the statement was made that if it were to be done again, this, as well as the other motions, would be made by electricity. The feed tables formerly in use in this place were operated by steam (with hydraulic

elevating gear), and the statement was made that the cost of operating the tables —repairs included—was less than half that of the former steam tables.

After the rolling is finished, the crop ends are cut off and fall into a pit from which they are taken by an elevator, likewise driven by a motor.

Alongside the rolls were the heating furnaces for the blooms. In front of the furnaces was a charging and drawing machine, and a buggy for carrying the blooms to and from the furnaces. The charging machine draws the hot bloom from the furnace and delivers it to the buggy, on which it rests on a set of carrying rolls. When the buggy receives the bloom, it at once carries it to the feed table, delivering it to the table by the rolls on which the bloom rests, which are operated by a motor of their own. In some cases the charging machine and buggy are one machine, but in the case referred to they were separate, though operated by one man, who stood upon the charging machine and from it controlled the buggy, sending it down to the rolls and bringing it back with the same facility as though he had been located on the buggy.

After the beam or rail is rolled, it is delivered to the hot bed, where it cools off. When cool, it is taken by a conveyor (elongated stationary feed table) also operated by a motor, to adjoining buildings, where the cold saws cut it to length, and ending machines take a rough machine cut from the end and remove the burrs. From here it goes to buildings where the fish-plate holes are drilled, if required, and to the straightening presses. The cold saws, ending machines, drill presses and straightening presses are all in some places operated by motors.

Two cases in which electric power had displaced hydraulic pressure were the adjustment of the rolls and crane service for handling the ladle of melted metal from open-hearth furnaces. With such furnaces it has been customary to use hydraulic swing cranes—each furnace having a crane standing alongside of it. From the length of an open-hearth heat, these cranes stand idle a large portion of the time, and the newer arrangement is to arrange an overhead electric traveling crane to serve several furnaces. In the present case this crane serves four furnaces, but has capacity for as many more, and will be so used as the plant is extended.

A rolling-mill plant includes a considerable machine shop, of course. Not only the roll-turning shop, which alone requires to be of considerable size, but shops for construction and repairs, and such machine work as may be required on the product, are necessary. To a considerable extent these shops are already driven by electric motors—a motor to each tool where the tools are large, or the motor driving several smaller tools through a line shaft. In one establishment, the entire roll shop was found driven by individual motors to each roll lathe, and in another the definite policy had been adopted of driving all future large tools in that way, with the motor incorporated in the tool as a part of it wherever practicable.

The most interesting single application found was to an open-hearth furnace charging machine. The charge is brought alongside the furnace in long iron troughs or buckets. The machine picks up the buckets one at a time, puts them in the furnace, turns them bottom up to empty the charge, withdraws the bucket and deposits it in place—repeating the operation until the charge is complete. The machine is almost human in its working, and it is hardly too much to say that it would not be a practicable machine with any other operating agent than electricity.

Another department of a steel works where electric power is found to be very convenient, is in the laboratory. Small amounts of power are here required for driving various grinding machines, ventilating fans, etc., for which the electric current is admirably adapted. Current is also required for electrolytic work. Formerly this was obtained from batteries, but at present the source is the central power station—not directly, however, but through a small motor generator which so modifies the voltage as to meet the requirements of the work.

One of the Pennsylvania steel mills has already installed four hundred motors, aggregating 3,500 horse-power. The results obtained have been so favorable as to lead to the definite policy of using electricity for all purposes for which it is suitable. Another was found having ninety-four motors in use, and plans developed for doubling the electric plant the coming season. A third had just installed a 200-kilowatt generator, directly connected to a 14 x 22 x 42 compound-condensing Greene engine, running at 120 revolutions per minute; the manager giving as the results reached, that they were doing work that could not be accomplished by any other known means.

One of the points which strike one in examining work of this kind, and in fact one of the advantages which are given as pertaining to the use of motors in these places, is the small amount of protection which the motors require. The example of the traveling cranes illustrates this, but it is seen everywhere. Motors are set up with but little more than a dry goods box to cover them from the weather.

Enough has been said to show the wide range of application which electric power has already found in rolling-mill practice. In all cases seen it was adopted in a small way at the start, and followed up cautiously and conservatively as its advantages and reliability were demonstrated by actual service.

In the last analysis, the fitness of the system—as was given at the beginning of this article—is due to the necessity for distributing power in some way from a central source and over a considerable area. Formerly this was done chiefly by steam, but electricity has been found to be less troublesome and cheaper, and its still wider adoption in the future seems to be assured. A system by which power can be conveyed by a simple wire, and can be made available at any point by simple contact, has obvious advantages in the way of adaptability and flexibility which are bound to be recognized and adopted as they become known.

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Destruction of the Weston Engine Shops.

A disastrous fire occurred in the village of Painted Post, N. Y., on the morning of May 16th, and, among other buildings, the works of the Weston Engine Company were totally destroyed. The safes of the company and a large portion of their patterns were saved. The loss is estimated at $100,000, with $40,000 insurance.

The firm had orders on hand sufficient to have kept them running for several months. A foundry has been leased in Corning, N. Y., and plans are under way for rebuilding on an extended scale. Like many similar disasters to establishments of this character, we have no doubt that this will prove to have been a blessing in disguise, and that the firm will very soon have an enlarged, improved and modernized plant. There is some talk of a change of location.

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The Plugged Safety-Valve Case.

The case of the engineer who plugged down a safety valve upon a steam tug in New York Harbor, as we noted in our last issue, was a more complicated one than at first appeared. The license of the engineer was revoked by the Board of Steamboat Inspectors, and the case will probably be brought to the attention of the Grand Jury.

It is now stated that some time ago the inspectors placed a locked safety valve upon the boiler, on account of statements made by former engineers, who asserted that they had lost their positions by refusing to carry more steam than the eighty pounds allowed her. The question naturally arises: What was the locked safety valve doing while the alleged plugging was going on?

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At the May meeting of the Engineering Association of the South, a paper was read by James C. Bradford, Esq., entitled "Engineers and Architects—Their Powers and Duties Considered from a Legal Standpoint." In the discussion which followed, it was suggested that, between a contractor and a railroad, the contractor should always be given the benefit of the doubt, because, as a rule, the life of a contractor is shorter than that of a railroad.

Letters from Practical Men.

Tool Boards.

Editor American Machinist:

Some time ago—I rather think that it was last year—there was an inquiry in the "American Machinist" about the best style of tool board to have on a lathe, and although I suppose I have seen every paper that has come out since then, I have not seen a word about tool boards. I am surprised at this, because it is really an important subject, and everybody that runs a lathe ought to know something about it. The trouble is, I suppose, that after all there is very little to say about the board itself. The size of the board is pretty nearly determined by the size of the lathe. The board ought to be as light as possible, and it is better to have it of some hard or close-grained wood, so that the little chips and dust will not bed into it and make it rough and dirty. The front of the board ought to come out even with the front of the ways, and if the lathe was narrow, or if a large board was wanted, it might hang over the back some distance. A couple of cleats on the bottom will serve the double purpose of stiffening the board and of keeping it in place on the ways. The board might be about as long in the direction of the ways as across the ways, and there should be a strip, say ½ inch thick and 1 inch high, all around the board to keep things from sliding off. I am not sure whether the front edge of the board ought to have a raised strip or not. All the lathe tools I would put in a row at the back of the board, and leave the front for whatever small tools were wanted for use—oil can, waste, wrenches, hammer, center punch, some calipers, and such things. One of the most important things in running a lathe is to insist, as far as possible, upon having every tool upon the board always ground and ready for instant use. It should not be the thing to run to the grind-stone every time another tool had to be used. Advantage should always be taken of times when the lathe feed was on to keep the tools ground up. This makes quite a difference if a fellow is going to run a lathe to get all or nearly all that he can out of it, and it makes a great difference in the looks of the board.

It is well to have another board, as long as will set upon the ways inside the horns of the rest and about half as wide, and without any cleats on the bottom or any raised edge. This will be handy to push around anywhere, to have one or two tools that you especially want and are constantly using about the job that you are on. This board will be very convenient to use inside the tail-stock when you are on chuck work, or anywhere along when you have a long piece on the centers. It will be light, and can be easily lifted or shoved around where it may be wanted.

This little board, or something corresponding to it, is very commonly found about a lathe, but what I don't see very often is a little board in front of the head-stock. I have found this a very great convenience—a light board, say about a foot square, with a raised edge and a couple of strips of iron, or some other contrivance, on the under side of it for hooking the board onto the front of the lathe. How to hook it on will depend upon the style of the lathe, and anybody can contrive that. It ought to be fixed so that it can be hooked on or unhooked at any time; but so that it will be right there most of the time, close to your left hand as you stand in front of the lathe, and so that you can have a wrench, or oil can, or waste, or calipers, or gages, or such things, right where you can pick them up or drop them down without moving your feet or turning your head. If anybody tries one of these little boards they never get along without it afterwards.

MORRIS FULTON.

Philadelphia.

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"Paying Wages by Check."

Editor American Machinist:

In your issue of May 14th your editorial on the above asks: "Are there any good reasons why men who work for industrial establishments and for railroad companies should not generally be paid by checks?"

Whilst indorsing your views generally, as stated in the above, I would say that there are some objections which may be briefly stated:

1st. The working man's leisure hours are at a time when the local banks are closed, and he cannot conveniently take the check there to be cashed.

2d. If you take it to the stores and ask for it to be cashed there, often it is done in such a way that you are made to feel they are doing you a great favor, and expect you to leave a good share of the amount there.

3d. If you live in the provinces, the amount of your check is noted, thereby giving food for gossip as to your weekly or monthly earnings, and there are some who at once set to work to spring some wonderful bargain on you, or speculate on how much you are "paying on your place," or how much you are saving out of it. Now, I think that sort of thing is distasteful to most of us.

You speak of the advantage of workmen making use of the banking system. There is an advantage certainly, if for no other reason than that a person has receipts always on hand; but to do so, a man must buy on credit, use a "pass-book," and at the end of the week or month draw checks to pay the different bills—a way of buying that often runs your bills higher than if you paid cash; for to draw a check daily for the butcher, another for the baker, etc., etc., would be out of the question.

I would like to suggest a way that I know has worked well with one family. The husband gets his money monthly. A portion of his wages are handed to his wife to do the housekeeping with for the following month, with the understanding that there are to be no debts incurred. That gives the wife an independence, and by careful management she can have some for her pin-money without having to ask for every five cents. The remainder is banked, and used as needed to pay the other and more weighty expenses, and is drawn out by check. He has the advantage of sending one of his family to the bank when deposits are made.

W. NEWTON.

Oneonta, N. Y.

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Fastening Piston Rods.

Editor American Machinist:

I have read with much interest Mr. F. A. Halsey's article on "Fastening Piston Rods," in the May 7th "American Machinist" and I think I can answer his questions.

The taper on the crosshead end, if properly made, is less in diameter than the body of the rod, thereby giving opportunity to turn down the rod when worn, and to bush the gland and slide it over the tapered end of the rod. The practice of some of making a square shoulder at the end of the taper is bad, as it should be rounded.

As to putting the rod in and taking it out of the cylinder, that is all imagination. You can know your length as well with this kind of rod as with a straight one, and simply make it that length. No trial is necessary. I will admit it takes a machinist to fit one; but when I buy an engine, I shall buy one of a builder that employs them to do the machine work. And it further has the advantage of being a tight fit, and insures the sliding surface at the crosshead being in line with the rod, and easily removed.

G. W. JORDAN.

[If it is desired to provide for future turning down of the rod, it may be done with the straight fit as well as with the taper, by providing a slight shoulder. How many rods with the taper end did our correspondent ever see fitted to the crosshead without cutting and trying, and how many such rods did he ever see made that were not first cut off with an allowance at the piston end for again cutting off after the taper fit had been made? Did our correspondent never see a tapered rod refuse to come out of the crosshead until reverse keys had been made to force it out? So far as alignment of the crosshead is concerned, no difficulty of that kind has ever developed, and with the depth of hole necessary for the key, and the necessary amount of metal in the rod on one side and in the boss on the other, all requirements of alignment are met if the fit is a good one.—F. A. H.]

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American Bicycles in England.

Harold Frederic, in one of his letters from London to the New York "Times," speaks of the increasing use of the bicycle in England, and says it is beginning to be realized that its use is not a temporary fancy, but that the wheel is bringing about "a vast revolution in the manners, habits and economics of national life which must profoundly alter everything." He informs us that the "Daily Chronicle" has just done what many of the leading papers here have long since been doing, and has started a regular cyclists' department; and its first article on the subject lays stress on the superiority of American models over the English ones, and warns the British makers that unless they reduce the weight of their machines, which are seven pounds heavier than the best American types, and adopt the American saddle and other improvements, they will lose the home market in competition with the Americans.

This is interesting, of course, and there is in it something to gratify our pride in the achievement of American mechanics; but there is another point in it, perhaps, and this point manifests itself plainly enough when one stops to think how many of our own newspapers would be likely to start a cyclists' department with an article comparing American wheels with English, to the disparagement of the former, supposing, of course, that the facts were reversed and that truth demanded such a comparison. English journals, generally, have the habit of "speaking out in meeting" when occasion demands it, and this habit is undoubtedly much better than our too prevalent one of thinking and saying in effect that all things American are necessarily superior to things of the same class in other countries.

In the matter of wheels, the facts are probably about as stated; but it is also true that most American wheels made last year were too light for ordinary road use, and Englishmen who favor copying American models might do well to reflect that most American riders do not expect to ride a wheel more than one season, and must have their '94 model in the spring of '94, and their '95 and '96 models in the following corresponding seasons. Few Englishmen would, we take it, be willing, much less bent on, buying a new wheel every season.

While it is true that we excel here in many things, it is also true that we are excelled in others, and one of the points in which we are surpassed by Englishmen is in the recognition and appreciation of what is done in other countries that is good and that may profitably be copied. Neither our English cousins nor ourselves are as liberal in this respect as we should be, and as we will be in the future, probably; but at present we are behind in this matter and are rather more complaisant than the situation justifies, and there is a little too much disposition to call ignorant bragging "patriotism."

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"Independence in Journalism."

In "Electrical Engineering" for May we find an article under the above title, which so completely voices the views and practice of this paper since its foundation that we give the following extract from it. The manner in which the public allows itself to be deceived by the most transparent paid advertising matter in the reading columns of many prominent journals, is beyond understanding:

"One of the first principles in honorable newspaper ethics is that honest and fair treatment shall be accorded to all alike, and to that end there must be a complete separation of the editorial from the business department, that the reading columns may be kept clean and untainted by partisanship or influences that would unduly direct the action of advertiser and subscriber. Especially is this true of technical and trade journals. The admission into the body of the paper of paid reading matter intended to promote the interests of some company, yet served under the guise of news, can but react most unfavorably on both subscriber and advertiser, and destroy the good reputation of the publication. For the subscriber will feel that his personal rights have been subordinated to the greed for gain, and that instead of the technical matter for which in good faith he paid there are offered descriptive articles suitable only for trade catalogs, while over the advertiser steals the feeling that an unfair advantage has been placed in the hands of his competitor by one who claimed to be—and from the very nature of things should have been—strictly neutral and loyal to first principles, yet who has been induced to swerve from the plainly marked path of honorable journalism in return for—cash."

[To all of which we say Amen.—Ed.]

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The British Consul at New Orleans has been studying the surface cars there and develops a number of interesting points. He says that no town has made more progress or at present has so perfect a system as New Orleans. In changing from mule traction to the electric system, there was a saving of 12 minutes to each passenger, or 10,000,000 working hours, equal to 1,250,000 days of eight hours each, or 1,000,000 days of ten hours. Valuing the time at only a dollar a day, here is an absolute saving to the inhabitants of a million of dollars for nothing. Quick transit not only saves time, but reduces rent, or makes better places accessible for the same rent. The Consul concludes that it is only a question of time when London and the European cities will have as good transit facilities as we have.

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"Paying wages by check" seems to have attracted general attention; we trust that our readers will feel at perfect liberty to give us their opinions on the subject.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(108) F. S., of Wolverine, Mich., says he has trouble with the feed-pipe of his boiler. It is located at the back end of the boiler in the combustion chamber, and gives trouble by burning off. He proposes to enter it at the front end over the fire-doors, and asks if this is considered a proper place. The boiler has no mud drum. A.—It is not safe to introduce cold feed water right over the fire, as our correspondent proposes to do. The plan advocated by the Hartford Steam Boiler Inspection & Insurance Co. is to enter the feed-pipe through the front end and at one side and above the tubes. The pipe is then carried inside the entire length of the boiler to the back end, where it crosses over and turns downward, discharging the water (which by this time will have become well heated) between the tubes and shell. The blow-off should be located where the feed now is, and, unless protected, will give trouble from the same cause. A cast-iron sleeve will make a good protector, which, to provide for easy renewal, should be in halves. The "Locomotive" for September, 1891, gives drawings of such a sleeve with internal lugs for holding the halves in position.

Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 26.

Forming Lathes, Mer. Mach. Tool Co., Meriden, C.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Honest Mach. Oils. F. S. Pease Oil Co., Buffalo, N. Y.

Bevel gears with planed teeth. Boston Gear Wks.

Engine Castings ¼ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Aluminum and Brass Castings, Machinery, Name Plates. Twining Campbell, Paterson, N. J.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Practical Guide for Firemen, by Wakeman; 80 pp.; 75c., post free; Am. Indus. Pub. Co., B'port, Ct.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Key Seaters for any length of hub or width of keyway. New, handy machines. Mitts & Merrill, 913 Tilden street, Saginaw, Mich.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, Tolland, Conn.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

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St. Louis Meeting of the American Society of Mechanical Engineers.

The thirty-third meeting of the American Society of Mechanical Engineers took place at St. Louis last week, in accordance with the program, the first session being called to order at 9 P. M., Tuesday the 19th, in the main parlor of the Southern Hotel, which was used as a place of meeting for all the sessions.

Col. E. D. Meir, speaking for the local Executive Committee, made a short address of welcome, explaining that he had been called upon to do so at short notice, because the Mayor of the city, who had been expected to perform that office, had at the last moment sent word that he would be unable to be present. Colonel Meir's address, in which he referred to special points of interest to engineers, and particularly to the fact that, in St. Louis, Captain Eads constructed the first fleet of ironclad boats ever built, was well received, and was briefly responded to by President John Fritz, on behalf of the society.

Refreshments were then served and an informal reception finished the evening.

Wednesday Morning's Session.

Professor Hutton first read the report of the tellers of election (of new members) and the reports of committees were then called for. The Committee on a Standard Method of Conducting Boiler Tests had no report to offer, and Mr. Henning, of the Committee on Standard Methods of Tests of Materials, stated that the work involved in the preparation of a final report had proved to be very great, that part of it which related to tensile strength of cast iron being especially troublesome. He hoped, however, that at the next annual meeting (next fall) a final report would be ready and would be presented. Under the head of "New Business," Prof. Wm. T. Magruder, of Nashville, very gracefully and very cordially invited the society to hold its 1897 spring meeting in Nashville, Tenn., the special reason being the Centennial Exposition, which is to be held there at that time. By vote of the society, the matter was referred to the Council for action.

"Strength of Cast Iron" was the subject of the first paper, and it was presented by its author, W. J. Keep. The paper contains all the results of tests of various sizes of test bars, made, in 1894, from different mixtures of iron for the committee referred to, and contains a number of charts designed to be specially useful to foundrymen who wish to know the relation between the behavior of any given test bar and a casting of any proportion to be made from the same iron.

Prof. C. H. Benjamin sent a written discussion of the paper, in which he expressed the opinion that the terms "modulus of elasticity," "elastic limit," etc., were entirely out of place as applied to cast iron, and should not be used at all in connection with that material, and that the usually accepted formulas for strength of beams would not hold good for cast iron beams, as had been shown by tests made by himself for the committee.

Mr. Kent told of an instance in which it had been shown that the elastic limit of cast test pieces was not at all clearly defined, and in which the modulus of elasticity might have been taken at any one of several different values, with equal propriety.

Mr. Henning referred to authorities who had long before discovered and announced this point, and said that recently constructed autographic apparatus by Olsen, of Philadelphia, in which the motion of the test piece was multiplied five hundred times, showed appreciable differences in behavior where none had been previously observed.

The Efficiency of a Steam Boiler—What Is It?

BY WILLIAM KENT.

This paper is a contribution to the discussion, begun by Mr. F. W. Dean's paper at the Detroit meeting, and continued by Dr. Chas. E. Emery's paper at the New York meeting last November, on the efficiency of steam boilers. The total unreliability of the "efficiency" of a steam boiler, as at present determined, is shown by the writer. An instance is given whereby the record of the efficiency of a certain boiler might be from 56.66 to 85.83 per cent., depending upon how the results are calculated and whose calorimeter is used. The author says that "if an engineer believes that 'efficiency' is a proper standard for builders to be governed by and to guarantee, then he should state in his specifications what kind of coal will be used in the test, what percentage of efficiency is required, and how the efficiency is to be determined; if by analysis, by what chemist, and if by calorimeter, whose calorimeter. The efficiency may conveniently be recorded in the result of a test as an addition to the time-honored evaporation per pound of coal and per pound of combustible, but I would by no means substitute it for these results, and especially I would not advise its adoption as a commercial standard to be specified in contracts or in guarantees."

As is usually the case with any paper that relates to boilers, this one occasioned more discussion than any other presented, and it is evident that diametrically opposite views are likely to be held regarding the meaning and value of boiler "efficiency" and "pound of combustible." What may be called the St. Louis and Chicago group of steam engineering experts claim that new conditions have arisen since the original committee formulated the present system of boiler testing, and that the term "evaporation per pound of combustible" has little definite meaning, especially when dealing with the inferior coals usually found west of the Allegheny Mountains. On the other hand, most of the Eastern men who took part in the discussion insisted that "efficiency" means little when applied to boilers, and that by proper selection of coal calorimeter, or of chemist to make analyses, almost any efficiency could be obtained, and widely different efficiencies had actually been obtained in this way from the same boiler trial. It is evident from the discussion of the paper that the committee which now has the matter in hand has no small task before it.

Test of a Four-Cylinder Triple-Expansion Engine and Boilers.

BY A. H. ELDRIDGE, ITHACA, N. Y.

The boilers tested in this case were of the vertical fire-tube type, rated at 150 horse-power each, and carrying 150 pounds pressure. Three boilers were used. The engine was a vertical, triple-expansion, open-front, with two low-pressure cylinders, 26 inches by 24 inches stroke; one intermediate cylinder, 23 inches diameter, tandem-connected to one low-pressure cylinder, and high-pressure cylinder, 14½ inches diameter, connected to the other. The results obtained do not seem to have been remarkable in any respect, except in the fact that the power required to run the condenser and feed pumps was not taken into the account in any way, and that a leak in one boiler, described as "quite bad," was allowed for at 2 per cent. in the results, the method of obtaining the rate of discount not being given.

Mr. Kent thought the paper presented no results of importance, and that it should have explained why the results were so bad.

Mr. Laird, who is connected with the

St. Louis water-works, noting that the water used in this test was determined by a meter, said that, while he believed in the meter for determining the amount of water used by a consumer, he did not believe, as a result of considerable experience with them, that meters were sufficiently reliable for a boiler test. The best he could expect of them was to be within a limit of error of 3½ per cent., even under the best of special conditions; and he thought that if the author of the paper had had more experience with water meters he would hardly make figures of evaporation and of water consumption to three decimal places and within one-tenth of 1 per cent.

Mr. Mansfield sent a written discussion, in which he expressed the opinion that such tests should more often be divided in definite periods of time, within which periods constant load should be maintained as nearly as possible.

Determining Moisture in Coal.

BY R. S. HALE, BOSTON, MASS.

This paper first gives some abstracts from the literature upon this subject, and then gives an account of the laboratory processes employed. The conclusions pointed out by the author seem to suggest more uncertainty than anything else in the results:

"First—If we use a large sample we must dry it a long time to dry the interior, and before the interior is dried the exterior will begin to oxidize.

"Second—If we allow lumps to remain in the sample, the lumps will not have lost their moisture when the fine coal has begun to oxidize.

"Third—If we pulverize the coal, this will of itself cause a certain loss.

"Fourth—If moisture corrections are to be allowed, a standard method should be adopted, giving the method of selecting the sample, the method of crushing the lumps in it, the size of screen it must finally pass through, the precautions to be taken if any time elapses between its selection and the moisture determination, the size of the sample on which the determination is finally made, the method, temperature and time of drying.

"It is probable that for each temperature and degree of humidity of the air, each coal tends towards some definite percentage of moisture, but that this percentage is continuously varying according to the previous history and treatment of the coal."

In discussing this paper, Mr. W. H. Bryan said he believed it was good practice to simply dry the whole of the coal to be used during the test, by spreading it out thinly and exposing to the air for twenty-four hours before using. The moisture left would be characteristic of the coal and could properly be charged to it.

Mr. Kent thought a good method of drying a sample of the coal might be to put it into a galvanized vessel something like an ash can, place this can in a larger one, and admit steam around the inner one to dry the coal by driving off the moisture.

Mr. Henning thought this would be objectionable, and that a better way would be to avoid heating and simply drive air through the sample of coal, the air being previously passed through calcium to remove moisture from it.

Mr. Cary spoke of a method of drying in which the moisture was driven off by heat, and in which a small flame was kept blowing across the mouth of the vessel. As soon as this flame showed, by its tendency to ignite the escaping gases, that volatile matter was escaping, the heating was stopped.

Wednesday Afternoon.

This was spent in an excursion about the city, which commenced and ended in special trolley cars, and included a carriage drive through Forest Park, where light refreshments were served at "The Cottage;" also drives through several of the fine residence portions of the city.

Wednesday Evening.

Several papers were on the program for this session, but Mr. Porter's paper was presented first, because it was to be illustrated by lantern slides; and there were so many of these slides, and the audience expressed such a decided preference for them, that they were continued until the close of the session—the papers down for this session being therefore postponed. The paper is entitled:

Hollow-Steel Forgings.

This paper refers not to solid forgings subsequently bored out, but to those which have been "forged hollow." The reasons for adopting the process are first spoken of, and the process is then described. Only open-hearth steel is used. The ingot is made at least twice the diameter of the finished forging required, and an excess of 25 to 30 per cent. in length is also provided for. A hole approximating that of the internal diameter of the forging is bored in the ingot, it is reheated, a mandrel is inserted, and the forging is then accomplished by hydraulic pressure. The metal, while fluid in the ingot, has been subjected to hydraulic pressure, the pressure being continued during the cooling. The superiority of the slow pressure of the hydraulic press to the blows of the most powerful hammer is pointed out, making the press practically imperative under the exacting requirements of modern manufacture. After the forging is completed, the annealing of it is an important and necessary process. The forging is heated slowly in a furnace, and then the furnace and forging are allowed to cool together. Annealing is said not only to relieve the forging of strains, but also to give it a finer grain and to increase its toughness. The process of "tempering" steel forgings is also treated of and its importance shown. The use of the harder grades of steel is generally recommended in preference to "mild" steel. Hollow-forged shafts, when all the best conditions of manufacture are adopted, are asserted to be as strong or stronger than solid shafts of the same diameter.

At the close of Mr. Porter's address, Mr. Fritz was induced to talk a little about the difficulties overcome in building up such a plant. He said that large wrought-iron shafts, which had been made with tools inadequate for the work, had given them so much trouble that he had concluded that cast-iron shafts of large size were much more reliable, and preferred to trust them. He told of some experience of theirs, in which they had purchased sections of forged wrought shafts of large diameter, and had bored holes through them. Finding them defective at the center, they had gradually enlarged the hole, and finally, in one case, split such a forging open and found it cracked to within an inch of the outside—the cracks being caused by the use of a hammer too light for the work, and which simply affected the outside only, directly, and really pulled the inside apart by stretching the outer portions. This confirmed their determination to put down a plant for the production of large steel forgings. Previous to the construction of this plant, compound armor plates, which had proven so successful abroad, were expected to be adopted here, but solid plates of steel made at Bethlehem had proven superior and were now universally used. The anxiety of the speaker was graphically depicted when on the day the first solid plate was tested with steel projectiles (cast-iron ones having been previously used exclusively), no word came from Annapolis when word was expected, but finally a telegram announced that the compound plate had been broken to pieces, and that the solid plate had stood the test.

Thursday Morning's Session.

At this session the papers on the program for the evening previous were presented in addition to the regular ones, and the first taken up was,

The Effect Upon the Diagrams of Long Pipe Connections for Steam Engine Indicators.

BY W. F. M. GOSS, LAFAYETTE, IND.

This paper gives an account of a series of experiments and their results, conducted at the Purdue University, for the purpose of ascertaining the effects of long pipe connections to indicators. The experiments were all made upon a 7¾-inch by 15-inch Buckeye engine. The power was absorbed by a friction brake. To the same cylinder were connected two indicators—one with a short and direct connection, and one with a long pipe connection, with means for changing the length of the pipe. The pipe was U-shaped,

nearly horizontal, with an elbow at the indicator end, and lengths of 5, 10 and 15 feet were used. Diagrams given with the paper show comparatively slight variations with the 5-foot pipe, while with the 15-foot pipe the differences in the diagrams were very great at every point. Diagrams are also given for different speeds and different cut-offs with the same length of pipe, showing, as might be expected, greater differences at the higher speeds, but with comparatively little differences for the different cut-offs. With the long pipe the events of the stroke are recorded later than with the short connection, and the limits of pressure, both upward and downward, are reduced.

There was no discussion.

A Hydraulic Dynamometer.

BY JAMES D. HOFFMAN, LAFAYETTE, IND.

This was a machine built at Purdue University, to make tests of the power required to drive some iron-working tools, such as lathes and planers, and a number of highly interesting diagrams made by the apparatus accompany the paper. The description of the principle upon which the machine operates is decidedly defective. The power is received upon one pulley and delivered from another, and the fluctuations of power transmitted are shown by a gage and are also traced upon an indicator card. By means of interchangeable gears, the paper is made to have different speeds, according to the nature of the machine or operation to be tested. Cards from a lathe show a reducing resistance as the diameter of the piece decreases; also the effect of sandholes in the casting is shown, and the increased resistance of a drill dulled by running on sand. Diagrams from shaper and planer are also given, with the planer operated successively upon cast iron, wrought iron and upon steel.

Mr. Henning thought the leakage of oil referred to by the author would result in a change of position of the pistons for the same load, and would vitiate the results to a certain extent, and that it would have been better if diaphragms had been used instead of pistons.

The author replied that the leakage of oil was but half a pint per day, so that for a run of twenty minutes the error would be inappreciable; and stated also that diaphragms had been tried in the instrument, but did not work so well. So far as friction was concerned, he said the instrument was too sensitive, rather than otherwise, and, in fact, seemed able to make statements based upon experience with the instrument, which statements answered practically all the objections that were brought against it in discussion.

A Study of the Proper Method of Determining the Strength of Pump Cylinders.

BY CHARLES W. KITTEL, CAMBRIDGE, MASS.

This paper presents an elaborate mathematical investigation of the stresses occurring in long, horizontal pump cylinders. The investigation is not of the barrel alone, but of the barrel casting, combining with it the valve check and other functional parts, which makes the problem in its entirety an extremely intricate one. The author says, in his conclusion, that he does not claim that his method secures results as definite as in many other problems of engineering; but still, admitting the correctness of the analysis of forces, the results follow inevitably.

Prof. Benjamin sent a written discussion, in which he called attention to the unreliability of formulas and figures as applied to cast iron, and said that some experiments on cylinders made by himself recently had shown that flanges exerted considerably more influence in preventing lengthwise fractures than was generally supposed. He said also that his experiments conclusively disposed of the theory sometimes held, that the stress of screwing up cylinder-head bolts should be added to the working stress.

New Form of Steam Calorimeter.

BY R. C. CARPENTER, ITHACA, N. Y.

As we are informed in a footnote, and as everyone knows, the name "calorimeter" does not properly express the function of the instrument, which is designed not to measure heat, but to measure the moisture carried by a sample of steam; but no one seems to suggest a more fitting name for it. The calorimeter described in this paper by Professor Carpenter has been in use in the laboratories of Sibley College for about a year. It is small and light, and in portable and convenient form. The paper, which is a short one, speaks of the questionable value of calorimetric determinations, on account of the difficulty of getting a fair sample of the steam, and yet suggests that the distrust of them may be carried too far. Professor Carpenter offers some conclusions that seem to be warranted by the present state of calorimetric practice: First, that the steam from a boiler of proper proportion carries an exceedingly small percentage of water. Second, a certain amount of water will be carried along as vapor or in small drops, the amount varying with the velocity but not exceeding two or three per cent. by weight. Third, water may be thrown out in large amounts, but this will flow in a stream along the bottom of pipes. Fourth, steam, even if dry, deposits a film of water on the inside surface of the pipe by condensation; and if the calorimeter is so located as to draw this directly into the pipe it may show very wet steam when the contrary condition actually exists. Samples should be drawn from a vertical pipe with an ascending current of steam. Fifth, a steam separator is always desirable, but is not essential in one case out of twenty, as the steam will usually take up all the water and retain it in a uniformly distributed condition. The last item, which, however, we do not give in full, does not seem to be very clear in itself, nor consistent with some others which precede it.

Geo. H. Barras vigorously attacked the paper, and seemed to differ from the author on about all the points brought forward, claiming especially that there would be deleterious radiation from the instrument, and that a statement of the author's, to the effect that experiment had shown that no appreciable radiation of heat took place from a water-glass, was simply an evidence of very rough and inaccurate experimenting. Professor Carpenter not being present, Mr. Barras was not replied to.

Mr. Bryan gave some results obtained by using three different types of nipples for connecting calorimeters to the steam pipe. Two of these agreed fairly, but the third differed widely from the two others.

Spring Tables.

BY G. R. HENDERSON, ROANOKE, VA.

The author of this paper read a paper before the society in December, 1894, giving several charts by means of which the various properties of a helical or an elliptical spring might be determined. In the discussion upon that paper, it was remarked that engineers generally prefer tables when designing, instead of working from formulas. The present paper consists almost entirely of tables compiled in accordance with the suggestion, and from the formulas in the previous paper. Comprehensive tables are given, covering elliptical springs from 1-16 inch by sixteenths to ½ inch in thickness, from 3 inches to 60 inches in length, and of any width. The helical spring tables are for round steel from 1-16 inch diameter by sixteenths up to 1½ inches, with various heights and diameters. The tables are intended to give the "solid load" and the ratio of "free height" to solid height for all practical varieties of helical springs. Only compression loads are considered.

There was no discussion of this paper.

The Effect of "Retarders" in Fire Tubes of Steam Boilers.

BY JAY M. WHITHAM, PHILADELPHIA.

The trials spoken of in this paper were made upon a 100 horse-power horizontal tubular boiler in Philadelphia. The boiler shell was 60 inches diameter by 20 feet long. There were 44 tubes 4 inches by 20 feet. The "retarders" were made of loosely-fitting strips of No. 10 sheet iron the whole length of the tubes, and twisted to a pitch of 10 feet, or making two turns in the length of the tube. The trials are described in detail, with diagrams and tables of results. An economic advantage of from three to eighteen per cent. is claimed for the "retarders" when the boilers are pushed, but there is no gain when they are run gently.

C. W. Baker sent a written discussion, in which he expressed the opinion that

the object of so-called "retarders" was not really to retard gases at all, but to increase the amount of heat transmitted through the tubes—first, by breaking up and mixing the currents of hot gases, so that all portions are brought into contact with the tubes; and secondly, by direct radiation of heat through the tubes. He described experiments made with a short vertical tube, in which he could place a "radiator" which consisted of two plane, sheet-metal pieces, so inserted as to cross each other at the center and divide the cross-section of the tube into four equal sectors. Arrangements were provided for passing a constant amount of heat through this tube by means of a lamp or gas jet, and the heat absorbed by water surrounding the tube was measured when using the radiator and without it.

Experiments with the apparatus showed the following general results:

1. That the percentage of increase in heat transmitted due to radiation increases with increase in temperature of the gases passing through the tube.

2. That the percentage of increase in heat transmitted due to radiation is larger in vertical tubes than in horizontal, on account of the fact that a given area of heating surface in a horizontal tube absorbs heat faster by direct contact with the gases than the same area in a vertical tube.

In general, the experiments showed that, with vertical tube heating surface and gas passing through the tubes at a temperature sufficient for the tube to transmit 1,000 to 3,000 B. T. U. per square foot per hour, the insertion of a radiator would cause an increased heat transmission of 200 B. T. U. to 1,200 B. T. U. per square foot of radiating surface per hour; or, in other words, the insertion of a radiator in that part of the tube in which the gas is of high temperature appears to increase the amount of heat absorbed from twenty to forty per cent.

The economic gain by the use of either radiators or retarders depends entirely upon the temperature at which the boiler is discharging its hot gases. In general it may be assumed that every 100 degrees reduction in the temperature of the waste gases represents from five to ten per cent. saving in fuel.

In general it will not usually be found worth while to introduce either retarders or radiators in the tubes of any boiler unless the thermometer shows its hot gases to be discharging at a temperature of over 550 degrees Fahr.

Mr. Kent called attention to the fact that the upper tube in a boiler usually passed the gases at higher temperature than the lower ones, and that retarders might properly be applied to the upper tubes only in some cases.

Another member recalled the fact that Isherwood had shown that better results were sometimes obtained by stopping up the lower tubes entirely, leaving the upper ones only operative.

The subject of cleaning tubes having been introduced, Mr. Rockwood spoke of the practice of cleaning locomotive tubes by air blast instead of steam, and said that it had been found much better, the tubes being more easily and more thoroughly cleaned.

A visitor, representative of the Serve tube, stated that they sometimes used retarders with the tubes, and mentioned a case where a boiler that did not steam well was much improved by putting retarders in the upper flues and increasing the draft, which was by forced blast.

Mr. Bryan thought the "retarders" were useful only in boilers not well designed or well adapted to their work, and that when a boiler had a proper amount of heating surface they were of no benefit. With the coals used in the vicinity of St. Louis, the draft was usually not as strong as would be advantageous.

Experiments With Automatic Mechanical Stokers.

BY J. M. WHITHAM, PHILADELPHIA.

This paper gives an interesting account of the trials of three different styles of stokers—the Wilkinson, with the use of steam in combustion; the Coxe stoker, using a graduated fan blast; and the Babcock & Wilcox stoker, under a strong natural draft. The Coxe stoker is used for buckwheat and rice grades of anthracite coal, the Wilkinson for either anthracite or bituminous coal, and the Babcock & Wilcox for bituminous coal only. The summaries of the results, both regarding the individual stokers and as to the general results, are remarkably clear and sharp. The general summary is as follows:

1. Each stoker seems well adapted to the conditions for which it was designed.

2. Each stoker gives ideal economic results when properly handled.

3. Stoker engines use from one-fifth to two-fifths of one per cent. of the steam generated.

4. Fan blasts use from three to five per cent. of the steam generated.

5. Steam blasts use from five to eleven per cent. of the steam generated.

5. A defect, common to each of the stokers named in this paper, is a too scanty air space in the grate.

7. Neither stoker will develop as much capacity as will hand-firing with stationary grates, having the same draft and coal conditions. Stokers, however, are not only more constant in the power developed than is a hand-fired grate, but are more responsive to fluctuations in the power demands. The stoker is always in the condition that a hand-worked fire is in just after its clearing, i. e., always clean and "ready for a pull."

Mr. Bryan said that experience had shown that no automatic stoker worked well with the low-grade coals of the West, and that hand-firing would always beat them; and Mr. Rockwood said that in New England it had been practically demonstrated that no one should put in a stoker with the idea of saving money by its use. A fireman with a shovel had been found to be the best stoker.

The Western River Steamboat.

BY WILLIAM H. BRYAN, ST. LOUIS, MO.

This interesting paper is avowedly in defense of the Western river steamboats. It was provoked by the remarks of a speaker before a convention of engineers last year, in which he said that great advances had been made in the lake marine, while the boats on the Western rivers differed little from those of fifty years ago; and charging that the decline of river business was due to the lack of better, cheaper and easily attainable facilities. The writer of this paper claims that the Western steamboat of to-day is admirably fitted for its peculiar work, and that, while preserving the original characteristics, it has undergone many improvements in detail.

The peculiar conditions of Western river service are enumerated as follows:

1st. Necessity for light draft, so that every pound of weight must be saved, necessitating high pressures, single cylinders, etc.

2d. Bad feed water, mud in mechanical suspension sometimes running as high as one-half of one per cent. by weight, with neither sedimentation, filtration or surface condensation practicable.

3d. Necessity of absolute reliability. The engines must always be under the quick and positive control of the engineer.

4th. The necessity of compactness to save room for cargo.

5th. Low fuel cost. This is treated as a relatively unimportant item.

6th. The first cost, which must be low, and is prohibitive of high-priced machinery.

Some detail drawings of steamboat engines, and also some indicator diagrams, accompany the paper; but no description of them is given in the text.

In response to inquiries, M. L. Hobman, of St. Louis, explained that, in navigating the Mississippi River, the main thing is to get up the river, and this must be done regardless of every other consideration.

Thursday Afternoon.

This was devoted to a river excursion, the steamer "City of Vicksburg" being chartered for the occasion, and, gayly decorated, it took the party above the city to the new water-works, Chain of Rocks, etc., lunch being served on board.

ST. LOUIS WATER WORKS.

No other supply being available, St. Louis has been compelled to go to the muddy Mississippi for her water supply, and the water-works system possesses some special point of interest. The Point

of Rocks Station, visited by the engineers, is five miles below the mouth of the Missouri, where on the rock bottom of the river is built a tower 1,600 feet from shore. Here the water is taken and passed through tunnels in the rock to the pumping station, where there are four pumping engines, located in two pits 57 feet deep.

The two Worthington engines each have two high and two low-pressure cylinders 21-inch and 42-inch diameter, 80-inch stroke. The machines are about 65 feet high, and each weighs about 1,000,000 pounds. These engines have pumped at the rate of 24,000,000 gallons per day, and gave a duty on trial of 96,770,000 per 1,000 pounds of feed-water.

There are two Allis engines also, which are compound-condensing, crank and flywheel, with cylinders 27-inch and 52-inch diameter, 108-inch stroke. On trial they pumped 930,000,000 gallons in 30 days, and gave a duty of 118,001,000. Water is first pumped into settling basins, of which there are six, and from these it passes by conduits to stations, where it is pumped into the service mains.

Thursday Evening

Was devoted to the reception tendered by the citizens of St. Louis, and held in the parlors of the Southern Hotel—a brilliant and much enjoyed affair, of course.

Friday Morning's Session.

As is usually the case with this session, it opened late, owing primarily to the fact that the reception was held the previous evening. The first paper was that of Professor Thurston, on "Superheated Steam." A footnote tells us that substantially nothing is being done in superheating on this side of the ocean, and that most all the information gathered from experts came from the other shore. The purposes of superheating steam are enumerated as: Raising the temperature, to increase the direct thermodynamic efficiency; surcharging the steam with heat, to prevent initial condensation; mimimizing the weight of steam entering the condensers; reducing the back pressure; increasing the efficiency of the boilers by reducing the quantity of steam furnished, and evading the waste from the production of wet steam. The methods both of superheating and of employing the superheated steam are quite fully rehearsed, and a set of conclusions are formally enumerated. From them we gather that superheated steam, as hitherto employed, has absolutely no thermodynamic value; that in the engine to-day its sole purpose and result is the saving of initial condensation, in which function it is very effective. We are told that the obstructions hitherto to the use of superheated steam have been in the destruction of packing and the decomposition of lubricants, but that these obstructions have now mostly disappeared. There still remains, however, much difficulty at the boiler. The more wasteful the engine, the larger the promise of gain by superheating. Small engines must profit by it more than large ones, slow engines more than fast, and simple engines more than multiple-cylinder ones. The larger the waste to be checked, the further should the superheating be carried. The extent of superheating should be controllable, and should vary with the rate of expansion.

In discussing the paper, Mr. Rockwood said it should be considered criminal to superheat by having hot gases on one side of a sheet and steam on the other. It was, in his opinion, very dangerous. He thought it was proper, however, and might sometimes be advantageous, to superheat by surrounding a portion of steam space by steam at a higher pressure and temperature, and he intended to make some experiments on that line.

A Self-Cooling Condenser.

BY LOUIS B. ALBERGER, NEW YORK.

This paper describes a practical apparatus employed for cooling the circulating water used in the condenser of a steam engine, so that it may be used over and over again. The cooling agent employed is atmospheric air. The paper describes or alludes to a number of devices that have been employed, and then goes on with the specific object of the paper. The cooling arrangement consists of a vertical cylindrical shell open at the top, with a fan at the side circulating air through it. The shell or tower has a grating near the bottom, and upon this rest layers of cylindrical tubular tiling. The hot water is distributed by a self-revolving jet at the top, and trickles down, over and through the tiling, collecting in a tank below the tower. The arrangement is described with considerable detail. The apparatus seems to be more efficient in summer than in winter, or at least the difference between the temperature of the cooled water and the air is less. By the use of the self-cooling condenser the advantages of condensation may be added to those of central and already determined locations, and the plant placed nearly if not fully on a par with the best and most recent practice of condensing engines with natural water privileges.

The paper was very generally indorsed and commended, the general opinion seeming to be that it treated of what must be regarded as the best and most advanced practice. In answer to questions, its author stated that usually about eight-tenths of the water required to operate a plant non-condensing would suffice to run it with this apparatus, and in some cases six to seven-tenths. Where a jet condenser is used the tiles soon become coated with grease, but so far, not to a deleterious extent.

A Classification and Catalog System for an Engineering Library.

BY F. R. HUTTON, NEW YORK.

The library of the American Society of Mechanical Engineers is rapidly growing, and Professor Hutton had to decide upon a system of classification for it, and the present paper describes the outgrowth of his labors. The Dewey decimal system is first discussed, and the decimal limit shown to be inadequate. In the classification suggested the numbers are carried as high as 33, with no limit to the additions that may appear to be necessary. The classes are each sub-divided, these sub-divisions being denoted by letters of the alphabet. An appendix to the paper gives the full list of the classes and their sub-divisions, as far as they have been carried out, and embracing a very complete and comprehensive system.

Mr. John B. Blood thought the system proposed was inferior to the Dewey decimal system, and explained the advantages of the latter at considerable length, showing thorough familiarity with its practical working from the standpoint of the user of an engineering library. He showed instances where the number of entries required in Professor Hutton's system would be greatly reduced in the Dewey, and declared that the latter had no such limits of application as supposed by Professor Hutton, and, in fact, generally supposed, since any series could if desired be extended from 9 to 99.

Mr. Kent also dissented from the author's views, and it became evident that no agreement on the subject was likely.

A motion made by Mr. Blood, for the appointment of a committee to consider the general subject of classification and cataloging, was carried.

During the discussion, Mr. Chamberlain described a method of dealing with trade catalogs, which consists of first securing duplicate copies of them, and then separating the leaves and pasting them on two sheets of manilla paper 18 inches by 24 inches, perforated on one edge for insertion in a binder. This permits convenient classification, gives volumes of uniform size, and sheets can be readily removed from the binders when desired.

Structural Steel Fly-Wheels.

BY THOMAS E. MURRAY.

In the power-house of the Albany Street Railway, at Albany, N. Y., a cast-iron flywheel burst last year with fatal and widely destructive results, and a description is here given of the wheel which was designed and built to take its place. As intimated in the title, the material used was open-hearth steel of a grade known as "shell steel," the hub consisting of a number of circular steel plates riveted together, and bolted to a central spider or separator of cast iron. Instead of the usual arms, dished webs were used, formed of sixty-four plates ¼ inch thick. The rim was made of eight 32-inch plates ½ inch thick, for the interior ring; then sixteen 40-inch plates ⅝ inch thick; 50-inch plates ⅝ inch thick; and outside all, another layer of 50-inch plates ⅞ inch thick. The weight of the wheel is about

58,000 pounds. The author regards the device of making disks or webs dished, instead of flat, as the most important feature of the wheel, but gives no reason for his belief.

It seemed the general opinion of those who discussed the paper, that the wheel would have been just as good if the webs had been parallel with each other instead of dished, and Mr. Henning thought the use of such large rivets up to 1¼ inches diameter was not good practice. Such rivets, he declared, should not be used when anything depended upon their heads, or upon their being properly upset. He also took exception to the statement of the author that the plates of open-hearth steel were placed with reference to the grain of the metal. Open-hearth steel has no grain.

This finished the professional papers, except that Secretary Hutton read, by title, a paper by Sir Henry Bessemer and James Dredge, of London, which paper was to give a history of the development of the Bessemer process, but did not arrive in time for presentation at the meeting.

Several topical questions were then taken up, one of them being proposed by Professor Goss, asking for experience of members in rebuilding machinery injured by fire. He gave his own experience, presumably, in connection with the burning of the laboratory at Purdue. The foundation on which a machine stood seemed to exert the most controlling influence in this case; those which stood upon good foundations being relatively little injured.

Mr. Suplee gave an instance in which a wrought-iron jib crane that had been through a fire was rebuilt at a cost practically equal to that of a new crane, the labor cost of straightening being about equal to the cost of the material.

Mr. Warner expressed the belief that any heat sufficient to melt the babbitt out of the boxes ruined the machinery and reduced its value to that of old iron. In cases where he had been called in to place a value upon such machinery, he had always endeavored to secure for the owner full value of the machinery.

Mr. Fritz tersely declared that machinery that had been through a fire should be put through another one.

After the usual votes of thanks had been given to the various committees and others, the society adjourned, the afternoon being utilized, however, by a visit to various points of interest in the city—notably Cupples Station and the Anheuser-Busch Brewery, both among the largest institutions of their kind in the world.

The St. Louis meeting, while not as largely attended as some others, was successful from every point of view, and the local members and citizens are entitled to a great deal of credit for the manner in which they conducted the social and entertainment features of the convention. The total registration was 236, of which 83 were non-resident members, 19 resident members, and 134 guests of the American Society of Mechanical Engineers.

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Uses and Advantages of a Public Supply of Compressed Air.

BY FRANK RICHARDS.

The Abolition of the Stand-Pipe and the Elevated Tank.

With a public supply of compressed air constantly maintained and always available, we come now to consider one of the most important uses of it, but a use which may be maintained at so little cost for the air consumed that it may be difficult to determine a basis upon which to compute it. The service involves not the actual use of a determinable quantity of compressed air, but only a taking advantage of the pressure of the air, and this in a way involving no reduction of that pressure or any absorption of the air volume.

Wherever water is distributed through pipes for general use, it is necessary to maintain a constant pressure upon it, so that it will readily flow where it may be wanted. If the water is obtained from flowing streams they are usually dammed at suitable places, or reservoirs are made for storing the water at such a level above the place of its use that the desired head or pressure may be secured. When the water must be pumped from a lower level to secure the necessary head for distribution, which becomes necessary under a number of different combinations of conditions—as, for instance, where the surface of a city is not level, and while the general water supply has sufficient head for most of the territory, it is not sufficient for the most elevated portions; or where the city is a dead level, and its entire supply must be pumped from lake or wells—then it is customary, usually by the device of a stand-pipe, to provide artificially an elevated surface for the water, equivalent to the reservoir surface, and capable of affording the required pressure. So when buildings are erected to a height considerably greater than it was ever contemplated to convey the water by the original water service, or where that service proves inadequate on account of the over-crowding of portions of the city remote from the source of supply, private pumping is resorted to, and in connection with the pumping the artificial head for the water is also employed; and so we have tanks in very general use upon the roofs of buildings or in their upper stories. In New York these tanks may be seen upon the roofs of the buildings in various parts of the city, while most of the tanks are not visible to the outsider, being in the upper stories, instead of upon the roofs, so that they will not be exposed to the frost.

Now, in the presence of a supply of compressed air the stand-pipe and the tanks on the roof are a manifest absurdity, and the original cost of them, with the cost of their maintenance, represents a great waste of money. If it is necessary to pump water in considerable quantities, it can, of course, be pumped by steam direct cheaper than to employ the steam first for the compression of air, and then the air for the pumping; but no matter how the water may be pumped, the air pressure may anywhere be used to advantage to maintain a head or pressure for it, rather than to depend upon gravity, and to carry the water to the elevation necessary to obtain the pressure by that means.

Say that a closed tank is provided, standing upon the ground, or in the basement of a building, or wherever may be most convenient, and that it is connected to the compressed-air supply so that it is full of air at our standard pressure of 100 pounds, and that the air-supply pipe is left open so that the air is free to flow into the tank or to be forced back into the air main, as the pressure may preponderate one way or the other: Upon pumping or forcing water into the tank a corresponding volume of the air will be driven back out of the tank, and the water will be under the 100 pounds pressure just as much as if that pressure were due to a vertical head of, say, 230 feet. This will be the pressure of the water at the tank level. If the water is conveyed by pipes from the tank in the basement to the upper stories of a lofty building, the pressure will be diminished in proportion to the height; and if the water is delivered at a level still lower than that of the tank, the pressure will be still greater than at the tank, precisely the same as if the pressure were due to gravity alone.

The use of the air pressure in this way, leaving it free to flow back and forth to and from the air main, seems to necessitate its employment only at the one standard pressure of 100 pounds, but it also assures to us the fact that the work of maintaining the water pressure is accomplished without the consumption of compressed air. This fact it is which makes it difficult to suggest what it would be fair to pay the Compressed Air Company for the connection with its air pipe, since, in the nature of the case, no meter could be employed. The service rendered by the compressed air would be a valuable one, and it certainly should be properly paid for, and this service should constitute an important source of revenue to the Compressed Air Company. It might be possible to meter the flow of the air in both directions, and from that to estimate approximately the work done; or if the water was metered, that would tell the story.

I assume all along that there are no leakages, and with good workmanship they should be infinitesimal, and they are hardly worth considering here. There would, however, under the arrangement

proposed, be a disappearance of a considerable quantity of compressed air. The use of compressed air for forcing water, instead of depending upon gravity, is already extensively adopted, but not in connection with an established public supply of compressed air, as I am now advocating. It is found that the presence and the pressure of the air upon the surface of the water results in its very thorough æration, thus accomplishing a most desirable result where the water is to be used for domestic purposes. It does not seem to be known how much air is thus absorbed by the water, but it would be an easy matter to ascertain it. Even this absorption of the air by the water might be largely prevented if the tank were a vertical cylinder with a smooth interior, and if a float covering the entire surface of the water was provided; but the æration of the water is such a desirable thing that the little air lost in this way would hardly be objected to.

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The Use of the Slide Rule.

BY F. A. HALSEY.

In Three Parts. Part I—General Principles.

So much has been written on the use of the slide rule that an explanation is in order from anyone who makes further effort in that line.

The slide rule is based upon the principle of logarithms, and the books treating of the instrument either presuppose a knowledge of logarithms or begin by developing the theory of logarithms, and on that base their explanation of the rule; or else they go to the other extreme, and ignoring its principles, endeavor to base the use of the instrument on the rule of thumb.

Now, any attempt to acquire independent and confident use of the instrument on the rule-of-thumb basis, will, in the writer's opinion, fail; while on the other hand, an understanding of the theory of logarithms is superfluous for this purpose. What is required is an understanding of the working property of logarithms and of the manner in which the rule is made to take the place of a table of logarithms, and this is very easily acquired.

While, however, the understanding of the slide rule is easily acquired, it is not to be denied that difficulties are encountered in acquiring facility in its use. Of these difficulties there are two. The first and greatest consists of the education of the eye to read the divisions correctly. This difficulty is a real one, but is certainly not one to be feared by anyone of intelligence. It grows out of the manner in which the rule is divided. With ordinary measuring rules, with which we have all been acquainted since childhood, each prime division or inch is divided like all the rest; and long before attention was ever called to the matter, we all learned to read these divisions instinctively at a glance.

In the case of the slide rule this is no longer true. To begin with, it is divided decimally, to which system the eye must become accustomed; and in addition to this, the prime divisions are of different lengths in different parts of the scale, and the number of subdivisions to each prime division necessarily varies with the length of the latter. Thus, the space between 1 and 2 is the longest on the scale, and is divided into ten main subdivisions; and on the upper scales, which are most used, each of these main subdivisions is usually further divided into five others. The space between 2 and 3 is smaller than that between 1 and 2, and consequently there is no longer room for so many subdivisions. The space between 2 and 3 is therefore divided into ten subdivisions as before, but these subdivisions are further divided into but two smaller parts. This arrangement continues until we reach the space between 5 and 6, which is so short that, after being divided into the ten subdivisions, there is no longer room for finer divisions, and they are omitted. This arrangement continues until we read 10, at the center of the rule, when the second half simply repeats the first half. The lower scales, which are of use principally in connection with square roots and areas of circles, are more open than the upper ones, and for the corresponding prime divisions have more subdivisions.

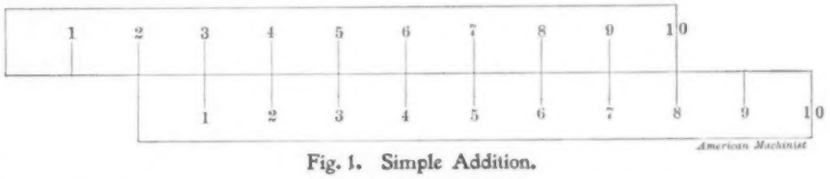

Fig. 1. Simple Addition.

Now, these varying subdivisions are puzzling to the eye until it has become accustomed to them, and the familiarizing of the eye with the peculiar arrangement of the scales forms the chief difficulty to be surmounted in learning to use the instrument. The second difficulty—though a smaller one than the one just described—is in finding the decimal point, for the rule gives figures only, and the pointing-off must be done mentally and by rule.

While these difficulties exist, they are not such as should deter anyone of ordinary intelligence from attempting to learn the use of the instrument. No one having many calculations to make can realize the relief from drudgery which the rule affords until he has tried it. The writer has used it habitually for fifteen years, and would almost as soon think of dispensing with a lead pencil as with the slide rule. It is undoubtedly the greatest mental labor-saver that has ever been devised. At the same time, it should be used with a full understanding of its limitations, growing out of its lack of absolute accuracy. Its limit of error (when of the usual size) is about one-half of one per cent. This is well within the limit permissible in most calculations pertaining to machinery; and aside from this margin of error, it is more reliable than mental calculations, and this statement is made with a full knowledge of a popular belief to the contrary. An error made with the slide rule is at once charged to the rule, while an error made in the common way is charged to the individual. In point of fact the rule makes no errors, and the user of it will make fewer in using it than in using the multiplication table.

As was explained at length in Mr. Jackson's articles on Logarithms, if the logarithms of two numbers be added together, the sum will be the logarithm of the product of the numbers. Now, the slide rule is a device for mechanically adding or subtracting logarithms, and this without consulting a table. The rule is at once a table of logarithms, combined with a device for adding or subtracting them and for giving the results in the natural numbers to which the resulting logarithms belong. It is not to be inferred, however, that it is necessary to keep logarithms and logarithmic methods in mind in using the rule. Once satisfied of the principle of operation, logarithms are no longer kept in mind. The user simply uses the rule, knowing that he gets the results of multiplication by mechanical addition.

To understand how a scale may represent a table of logarithms, imagine a rule without divisions. As a first step, divide it in half. Call the left-hand mark 1, and the mark at the middle 10. Now imagine a scale of equal parts so divided that the number of divisions between 1 and 10 of our slide-rule scale shall equal the logarithm of 10. Count off as many divisions on the equal part scale as will give the logarithm of 2, and there locate 2 on the slide-rule scale, and in the same way lay down points for 3, 4, 5, 6, 7, 8 and 9. Similarly, lay off points to the right of 10 for 20, 30, 40, 50, 60, 70, 80, 90 and 100. In point of fact, however, the logarithm of 100 is twice that of 10; and hence, 100 will be as far to the right of 10 as 1 is to the left. Also, 20 will stand at the same distance to the right of 10 that 2 does to the right of 1; and so for 30 and 3, 40 and 4 and so on. In other words, the right-hand half of the scale will simply duplicate the left-hand half. In the same way, we might go on and locate points for 200, 300, 400 and so on up to 1,000 and beyond, but the result would be found to be to duplicate the scale again and again, each multiplication of the numbers laid down by 10 simply repeating the scale that we already have between 1 and 10. Since, then, the scale between 1 and 10 is the same as that between 10 and 100, 100 and 1,000, or

100,000 and 1,000,000, it follows that we need not repeat the scale indefinitely, but may let the 1 of our scale stand for 10, 100, 1,000, 100,000 or 1,000,000, as convenient; the 2 standing for 20, 200, 2,000, 200,000 or 2,000,000 in the same way. This is constantly done in the use of the rule, the operator soon losing sight of any absolute value as belonging to the divisions, and finding on his rule the figures of his quantities without regard to their absolute value. Thus, he looks in the same place for 215. that he would for 2.15, 2,150 or 215,000.

It will occur to some that, if each scale is like all others, a single scale would answer all purposes; that is, we might have our 10 at the right-hand end of the scale instead of at the middle, as described—the whole length being occupied by the scale between 1 and 10. This is a fact; and most rules are, in fact, made both ways—the top edge having two scales to its length, and the bottom edge one. Since the French and German rules have come into vogue, most of the books written for them have recommended the bottom scale for everyday use in multiplication and division. Certain inconveniences, however, attend that method, and the writer follows the old-fashioned way, and uses and recommends the use of the top scales as was taught in the old days when the English rules were the standard. There is no denying that the lower scales give more accurate results, as their greater length gives room for finer subdivisions; but this is more than offset by the inconveniences referred to. In the writer's practice, the use of the lower scales is confined to the uses for which they were originally intended—in connection with the upper scales for the solution of problems involving square roots, areas of circles, etc., and he so recommends their use to others.

The rule described above—having upper scales of stock and slide alike, with two scales to their length; and the lower scales of stock and slide alike, with one scale to their length—comprises the Mannheim arrangement. There are others; but the Mannheim is the best, and is recommended. The rule should also have a "runner" or sliding index—as, indeed, most rules made to-day do have.

It has been explained that the purpose of the slide rule is to add (also subtract) logarithms. The manner in which it does this may be illustrated by two ordinary measuring rules, or by two slips of paper divided into equal parts. Thus, in Fig. 1, let us add 2 and 3 by the slips. Draw the lower one out until its end stands at 2 of the upper one, and proceed to the right on the lower slip until we reach 3. This 3 stands opposite 5 on the upper slip, which is the sum of 2 and 3. In the same manner, proceeding in the reverse way, we may place 3 against 5, and then going to the left, find at the end of the scale 2, which is 5 less 3.

It has been explained that the divisions on the slide rule represent the logarithms of the numbers placed opposite the divisions, and a similar procedure with the slide rule will add the logarithms, precisely as the slips of paper having equal divisions added those divisions. It is to be noted, however, that while the length of the divisions of the scale represent logarithms, the figures opposite the divisions give the numbers to which the logarithms belong. Hence, we start with natural numbers, which the rule, by its divisions, translates to logarithms. These the rule adds or subtracts, and then translates the results back again to natural numbers, and all without effort or thought on the part of the operator.

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Inspection Tests.

BY B. F. SPALDING.

The success of modern systems of manufacture depends upon the thorough inspection of the work at the right stages of its progress, and upon the tests which are made of the completed, assembled machines, to make certain that they are, in every point and respect, what they were intended to be, and that they will do all that they are required to do, and endure all that they may be reasonably expected to endure. The anxiety is overstrained, and the precaution unwise, which exacts tests of excessive severity. It has been claimed of ordnance, boilers, anchors, chain and other things, that the tests to which they were subjected were so much greater than any to which they might reasonably be expected to be exposed, that they were unnecessarily strained and weakened by them, and that, in fact, they were not as trustworthy after they had safely passed through the inspections and tests as they were before. It is universally conceded that while the tests should be positive, and not capricious, they should not be excessive. For this reason the Government inspection, which is disinterested when honor is prized, has from time to time been modified to accord with better understanding of the conditions of service. Professor Thurston, in "Materials of Engineering," cites an instance of this: He says: "The Committee on Chain Cables, reporting to the United States Board, appointed in 1875 to test iron and steel, etc., objected to the then standard cable proving strains, asserting that, as tension in excess will probably injure the cable, it becomes a matter of importance to fix upon a strain for each size which, while sufficient to secure the detection of unduly weak links, will not produce such." The committee, therefore, after a series of experiments made especially for the purpose, recommended variations of the proof stress in accordance with the results obtained. This table of tests was approved by the Navy Department; and instead of stressing the cable up to from 54.3 per cent. to 66.2 per cent. of its probable ultimate strength, as had been the previous practice, it reduced the proof stress to from 45 to 50 per cent.

The committee said: "Should there be by accident a few links of $1\frac{15}{16}$ inch in a 2-inch cable, the Admiralty proof would strain the strongest of such links to over 62 per cent., and the weakest to over 70 per cent. of the actual strength." The province of inspection is to eliminate the dangers of accidents, and discover them, and remedy them, and not to provide a method of avoiding responsibility for them.

Government tests are for the protection of the servants of the Government. Some idea of what they are like may be formed by an examination of the tests to which breech-loading rifles were put, which were presented to the Government to select from, to obtain a model for adoption. Eight tests were prescribed: The first two were for rapidity of fire. III. For endurance—the gun was to be fired 500 continuous rounds without cleaning. IV. To observe the effect of exploding defective cartridges. V. Dust—The piece to be exposed in a box, prepared for that purpose, to a blast of fine sand dust for two minutes; to be removed, fired 50 rounds, replaced for two minutes, removed, and fired 50 rounds more. VI. Rust—Rusted in brine, exposed two days in the open air, and then fired 50 rounds. VII. Excessive Charges—To be fired once with 85 grains of powder and one ball of 450 grains of lead, once with 90 grains and one ball, and once with 90 grains and two balls. The piece to be closely examined after each discharge.

These tests were suggested by the world's experience. They were not such as would occur to a person ignorant of arms. Who would think that it would ever be necessary to use a gun like that, or that any gun would endure it? But in one year, when ninety-nine different models of guns were thus tested, a majority of them passed these tests safely.

There seems to be something fascinating in putting machines to supernatural risks. Men drive mowing machines across railroads and up against fence posts, not because they ever expect to make hay of steel rails or fence rails, but to exhibit qualities which their regular work will never demand. Reckless engineers drive traction engines over piled-up-obstructions, apparently out of pure deviltry; although after investigating the tests devised by men of acknowledged scientific attainments and solid practical judgment, such as our ordnance officers were in the days of Ripley and Dyer, we can hardly perceive where the requirements of science terminate and the exhibition of recklessness begins. It has been demonstrated that the Springfield rifle will stand 120 grains of powder and three service bullets, weighing together 1,265 grains, and that the barrel will endure at least 10,000 service fires; the steel barrel will stand a

charge consisting of one proof bullet, and powder enough to fill the bore to the muzzle; and an iron barrel will stand about half this charge. In either case, a great deal of the powder will not burn until after it leaves the gun. It is said that in the bright days of Kentucky riflemen, their practice was to load powder enough so that part of it would fall unburnt upon the snow.

Tests should not be capricious. The test for swords is positive when it requires that they shall be bent over a block, curved to a circle of 35 inches, until they conform to it, except next the tang, and shall regain their original straightness upon being released; but it does not, at a first glance, appear to be as positive when it dictates that the sword shall be struck twice on each of the flat sides, on an oak block of the same curvature, because it seems as though this test would depend as much upon the spring of the man as upon the spring of the steel, the temper of one being pitted against the temper of the other; but it is found, taking one day with another, that this test is fairly uniform, the habit-form coming in here and equalizing the force of the blows.

The American system of manufacture is supposed to insure, by inspection, that nothing shall go out of the establishment unless it is right. Here is a case where, in spite of a system of inspection, there was some loss and more vexation, caused by imperfect machines getting away from the manufactory:

One of our large establishments, which exports many of the excellent machines it builds across the waters, met with a singular accident recently. It had sent off at one shipment about $30,000 worth of machines, and they had been delivered to its English agents, when back came a cable dispatch saying that they were all wrong. As the machines were all inspected before they left the works, this was surprising information; and the result of it was that in a few days, thanks to the ocean greyhounds, the senior partner of the concern was inspecting them individually on British soil. What he found to be the matter with them cannot be told without telling what they were. Suffice it to say that the fault was not with the inspectors; but the living cause was a man with more authority than judgment or acuteness, who had stupidly and peremptorily given orders to leave off a certain projection on one of the minor parts, which did not affect results under the usage to which the machines were generally put in this country, but which happened to be necessary to their proper performance under the conditions to which they were obliged to conform in England. Three things resulted: The remedy, the retribution, the reformation.

The remedy was to have them all overhauled right where they were, in England; and although the expense of readjustment did not exceed $2,000, the annoyance of such an aggravating incident, consequent upon a foolish, conceited disposition to be incessantly meddling, was very irritating and provocative of unamiable reflections.

The retribution necessarily stopped at the removal of the living cause—still living—there being no law in this very young country which would allow of his being burned at the stake, or of his literal decapitation.

The reformation took the form of an irrevocable edict that henceforth no change should be made in any machine unless it was authorized by a certain "Council of Five," which was thereby formed and appointed, three of whom were of the office and two of the shops. This very wholesome regulation serves to ballast the concern, and it will probably henceforth weather the storms with a steady keel.

All of this trouble might have been prevented if the assembled machines had been tested at the factory, especially to see if they would do aright that particular little thing which they failed to do. It was too insignificant until it was found to be in error, and then it loomed up like a mountain.

Here is a case where the inspection discovered a curious accident, which might have led to unfortunate results, if it had not closed a hole when it converted tough iron into brittle steel:

It was in the early part of the War; the armories were all working, as the saying is, "from hand to mouth." The troops in the field wanted arms, and the armories were delivering as fast as they made. A contractor for forging, hardening, and blueing, at one of the private armories, had a batch of a thousand gun hammers ready to be case-hardened the day before Christmas.

To case-harden the parts of a gun, the pieces are packed in iron boxes with animal charcoal, such as burned bones or charred leather, broken up into pieces the size of peas; all the space in the boxes between the pieces being filled with this "brasque," as it is called. The boxes are then covered over tight and luted with clay, and placed in furnaces where they are kept at a red heat, until the necessary chemical changes and reactions have taken place, when the boxes are taken from the fires and their contents dumped into vessels of water. The outer cases or surfaces of these pieces having been converted into steel by the action of the carbon, there is a skin over them of greater or less thickness, which becomes very hard by this sudden cooling in the water. It is a process of unrivaled excellence for such articles as are required to possess external hardness and an inherent toughness, as they can be made hard without being brittle; and the outside steel surface is not subject to internal strains, for the reason that the outside, having in it not only iron, but carbon also, does not get as small after hardening as it was before, while the iron inside has a tendency to return to its original size. Hence, all the strain which is set up by the process is drawing the shell closer together, instead of tending to burst it open.

There are different modes of case-hardening which are adapted to different kinds and qualities of iron; some need a longer and some a shorter exposure to produce the desired chemical change.

If the operation is continued beyond a certain length of time, with burnt bone, the carbon is exhausted and the iron, instead of being carbonized only, is partially phosphorized. The atmosphere in the boxes is changing during the whole time, the more volatile gases filling it first, and the more fixed gases being extracted from the brasque by longer heating and taking their place. If pieces are subjected to a red heat in fresh animal charcoal for two hours, and then put into a box with fresh charcoal and kept hot for two hours longer, they will not be chemically affected in the same way that they would be if kept in the first box for four hours. The difference would be a great deal more if the animal charcoal was from bone than if it was from leather. Iron, which is to be hardened from bone, must be very free from phosphorus, or it will be quite liable to become very brittle before it becomes very hard.

The kind of iron our contractor had in hand was of excellent quality, such excellent quality, indeed, that one of our largest and most famous iron masters went to England and used a great deal of effort to obtain the secret of its manufacture—and succeeded. It was Marshall iron. This iron was so perfect that it was used for the famous Adams revolvers, the frame and barrel being forged in one piece, and the bore being longitudinal with the grain. But it was seamless iron. This iron required but a short exposure to acquire the requisite temper by the case-hardening operation.

Something went wrong with the furnaces, and it was nine o'clock at night before the last box was removed from the fire and dumped into the water, and the hammers taken out and laid on sheet irons, placed over the inverted hot boxes to dry off. There they were left, for everyone was in a hurry to get to the Christmas festivities, which in the bar-rooms of that vicinity began any time during the week, and lasted without intermission until everybody was drunk or in durance—more or less—vile.

Christmas, it snowed and blowed—terrible storm! It was Thursday. Friday and Saturday hardly anybody worked but the assemblers, and Sunday, of course, not much was done; but Monday, assembling came to a halt. No hammers! Go to inspector's room—none there. To the polishing, then—sent to be case-hardened. To the case-hardening room—ruin, ruin everywhere. The storm had beat in the

roof, and the debris and snow and ice lay two feet deep on the floor—and the contractor had not showed up. Picks and shovels and crowbars found the hammers after a while, and they were melted out of a frozen mass of iron, cinders and ice, sent to the polishing room to be re-surfaced, and were then reheated, care being taken not to expose them any longer than was deemed necessary to get the beautiful variegated colors which cannot be obtained in any other way than by case-hardening.

At last — everybody waiting — the sprightly roustabout, conscious of his precious burden, reached the inspecting room with them. A handsomer lot of case-hardening never showed up to expectant eyes. This test gage is all right. It goes into the receiving gage also. One test more; put it on the square plug and notice if the break reaches over to the right point.

Ha! it will not go on the plug; the square hole into which the shank of the tumbler goes has shrunk. This happens quite often and we drift them out. A square drift is inserted, and a light tap given with a hammer to drive a drift in and spread the hole. Snap! it bursts like a piece of glass.

"How long have you been making your hammers out of steel?" asks Col. Hagner, the Chief of Inspection, of the Master Armorer, as he carefully examined the grain of the material which was exposed by the fracture.

The extra heating, which it had been necessary to give the hammers, had really changed the nature of the material so that all of them were necessarily doomed to the scrap pile, as even annealing failed to restore them on account, apparently, of some change of the nature of crystallization.

The assembling of guns had to wait another day, until a fresh lot of hammers could be pushed along. Meanwhile the troops in the field glared at the enemy and growled at the old flint-lock muskets, not knowing that they might have had something worse—percussion breech-loaders with broken locks.

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Literary Notes.

PRESS WORKING OF METALS. By Oberlin Smith. 6 x 9 inches, standard size; 276 pages; liberally illustrated; bound in cloth. Published by John Wiley & Sons, New York. Price $3.00.

The name of the author of this book will be familiar to our readers as that of an occasional contributor to our columns, and most of those who know anything at all of sheet-metal working know of him as the designer and builder of many very successful sheet-metal-working tools and machines. The literature of the subject he has taken up is by no means abundant, and, in fact, those who have occasion to refer to it will be much more likely to encounter Mr. Smith's writings than those of any other author. His experience has been a long and varied one; and as he has the habit of study and of reasoning about things, he has been able in this book to give us a valuable addition to our stock of "classified knowledge," which has been called science. Those previously unacquainted with the work of cutting, pressing, forming and drawing sheet metals will find much to instruct them in this work, while most of those who have had experience with it will yet find here recorded experience which goes outside their particular field of exploration. The work does not pretend to tell all there is to be told about working sheet metals, but it does treat of the principles involved in the art, and those who are interested in such work should have the book at hand.

JOHNSTON'S ELECTRICAL AND STREET RAILWAY DIRECTORY FOR 1896; Containing Lists of Electric-Light Central Stations, Isolated Plants, Mining Plants, Street Railways, Telegraph, Telephone and District Messenger Companies, and Manufacturers of and Dealers in Electrical and Street Railway Apparatus, Machinery and Supplies. 6 x 9 inches standard; 832 pages; cloth. New York: The W. J. Johnston Company. Price $5.

This book is an excellent illustration of the extent of the development of electrical industries. Its scope includes the United States, Canada, Mexico, Cuba, Central and South America. In its production the object of the compilers has been to furnish reliable information regarding electrical, street railway and kindred interests, so arranged and classified as to be easily accessible. The book gives the names of officers of electric light, street railway and other companies, as well as particulars regarding the various companies—such as capital, system used, number of lights operated and prices charged by lighting companies, and length of line and number of cars operated by street railway companies. The extent to which electric traction has displaced other systems in street-car work is shown by the fact that, out of a total, in the countries named, of 1,140 street railways, 828, with a gross mileage of 14,450, are operated by electricity, and 312, with a mileage of 2,300, by horse, steam or cable power. The directory also gives a list of 7,150 electrical engineers, manufacturers, and dealers in electrical machinery, arranged geographically, according to business and alphabetically.

TRAITE DES MACHINES-OUTILS (Treatise upon Machine Tools) By Gustave Richard, Member of the Council of the Society for the Encouragement of National Industry, and of the Committee of the Society of Civil Engineers. Paris: Librarie Polytechnique; Baudry et Cie, Publishers, 15 Rue des Saints-Peres.

Machine tools form so vast a subject that the two massive volumes which compose this work show no signs of padding. The author has omitted theoretical data almost entirely, and relies for a concise presentation of the subject largely upon the illustrations, of which there are 5,854 in all, well divided between perspective and sectional views. The first chapters of the first volume are devoted to a description of the principal types of lathes, the details of their construction, and lathe tools and lathe work. Then follow boring machines, planers, slotters, universal planers, shapers and key-seating machines, with a consideration of the various types of drills, ordinary and special. In the second volume are taken up, in order, milling machines, gear cutters, grinding machines, thread-cutting tools, auxiliary machinery, including metal saws and small tools. The products of American manufacture are accorded such a large share of space that the book appears like a treatise upon American tools; and there being nothing in the title to indicate this fact, one is led to infer that our machinery has a clean sweep abroad. However, it is explained in the preface that so many of the materials are drawn from English and especially American sources because they will furnish most of novelty to the readers of the book. A large share of what is to be found in these volumes will naturally be familiar to regular readers of the "American Machinist," but its publication in the French language will place it before many new people. The author has added to the literature of the subject in hand a work of perhaps greater magnitude than any other, but one that is nevertheless as well adapted to every-day service as the dictionary or the encyclopedia. We see no reason why it may not fulfill his expressed wish, and become a useful addition to that important branch of technology which relates to machine tools. The two volumes are 11 x 14 inches, and together contain 1,096 pages.

"Alden's Living Topics Magazine and Cyclopedia." This is a publication of which it is difficult to speak fairly. Everyone knows that the objection to even the best and most comprehensive encyclopedia is that it is never up to date. This feature is sought to be remedied by the present publication. Pages of encyclopedic matter are issued a few at a time, weekly, and on the price basis of 50 cents per 500 pages. These are later collected in little, handy volumes, the first of which is before us, embracing various topics from "Abbas" to "Brawn." The pages are not numbered, but there seems to be about 160, and the price is 50 cents. When the alphabet has been run through with, a beginning is to be made again, and so on as long as the publication lives. The matter seems to have little interest except for reference as questions arise. It has the appearance of being correct and carefully compiled. New York: John B. Alden, Publisher, 10 and 12 Vandewater street.

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The Franklin Institute of Philadelphia has awarded the Edwin Longstreth Medal of Merit to the Cleveland Twist Drill Company, for their grip socket for holding and driving taper-shank twist drills. Very good, but give us heavy cash sales for our Medal of Merit.

Commercial Review.

NEW YORK, SATURDAY EVENING, MAY 23d.

Machinists' Supplies.

When so many factories are suffering from lack of work, it is inevitable that the minor supply market should remain in a quiet state, and consequently the reports of many months past have been principally of an unfavorable nature; but at hardly any time during this year does it seem that there has been in this city a greater unanimity of complaint at the tendencies of trade in small machinists' supplies than now exists. Few, indeed, are the sellers who hold that the May demand is any better than that of April, and the general opinion is that it is worse. May naturally should be a good month, some say; but this one has been anything but what it ought to be. June, also, might be a season of activity, and perhaps it will offer some relief from the present deplorable situation; but, then, if May has thus far proved a traitor, perhaps June may prove the same. A good thing for sellers to do would be to husband their resources until autumn, and not be disappointed if no radical change takes place before the return of cool weather.

The effect of all this is to keep prices generally down to at least as low a notch as they have been at in the past. When they are fixed arbitrarily, that is another matter. Attempts have been made to strengthen bolts and nuts, and it is reported that other products of iron, chain, beams and hammered steel billets are also being manipulated.

A local seller of small tools and miscellaneous supplies informs us that he finds the market for those lines which are used in bicycle work as brisk as ever, remarking, by the way, that he has heard this week of three jewelers going into the bicycle repairing trade. Possibly that may help to explain the excellent demand reported in the following letter from a well-known twist-drill company, which company would appear, however, to have received more than an average share of the orders this year in the market:

"Business in our line for the whole of this year since January 1st has been exceedingly good. We have run our works to its utmost capacity, but our sales have exceeded our product by quite a large percentage. Usually at this time of the year there is quite a marked falling-off in the demand for our goods, but so far this year we have not experienced this ordinary change. We seem to be receiving as many orders as we did during April, and we are doing quite a large amount of business; more than in the month of May, 1895."

Power-transmitting machinery is, according to general opinion, no gainer with the advancing season, though one of the most prominent firms in this city report that they are doing a considerably improved business. The criticism of one seller upon the market is as follows: "Business has sagged off, although not very materially, after a flurry in small work that took place apparently in connection with the May 1st moving. I think business will keep on about the same. People have specifications for work out, but delay placing the orders, owing to the uncertainties of the currency question, etc." A wood pulley seller who, a month ago, was remarkably bullish, is now just as bearish.

Locally, at least, and at the present time, the emery-wheel trade suffers in common with other lines. Two concerns in this city, handling especially, or exclusively, emery wheels, agree that trade has been duller this month than it was last. Says one, in effect: "Trade was fair in January and February, but declined in March, and has been going from bad to worse ever since." The other: "Our business is not quite as good this month. Prices have been for a long time demoralized, but there is no appreciable change from month to month. The small machine shops seem to suffer most from the hard times." Another company's business this year, at their New York branch, is considered about equal to that of last year, and fully holding its own this month, while the first three months of this year were found at their main office to be the best for the corresponding period in two years. Somewhat in the same tenor is the following report, under date May 11th, received from the Norton Emery Wheel Co., of Worcester, Mass.:

"In our line of business there appears to be considerable life and activity, and in comparing the first four months this year up to the 1st of May, we find that the net sales are 38 per cent. more than for the average of last year, which is very satisfactory to us from the fact that last year's business—i. e., 1895—was 33⅓ per cent better than the previous year of 1894, and 20 per cent. better than the best previous year, which was 1892. Mails continue good, and we see no indications of 'letting up' as yet."

Wrought-iron pipe and boiler tubes continue to be very dull indeed. There is little or no improvement. The building trade constitutes an important factor of demand in this market. Jobbers' prices have been very weak, since they have had large stocks on hand and have exerted upon the market considerable pressure to sell; but it is said that their stocks are now somewhat reduced. The outlook for better prices is very indistinct. A new price list in fittings is about going into effect, but the advances made will probably be neutralized by discounts.

In leather belting there is not much more doing than last month, and it is hard to determine whether any betterment at all has taken place, although some merchants say that there has. Since hides have advanced 20 per cent. or more within about a couple of weeks, it looks as though prices of belting were eventually to be higher.

The price of copper is becoming considerably stronger, and tin is firm, with the best statistical position of this year.

Quotations.

NEW YORK, Monday, May 25th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 50 @ $13 25
No. 2 foundry, Northern	12 00 @ 12 50
No. 2 plain, Northern	11 00 @ 11 50
Gray Forge	11 25 @ 11 75
No. 1 foundry, Southern	11 75 @ 12 00
No. 2 foundry, Southern	11 25 @ 11 50
No. 3 foundry, Southern	10 75 @ 11 00
No. 1 soft, Southern	11 25 @ 11 50
No. 2 soft, Southern	11 00 @ 11 25
Foundry forge, Southern	10 25 @ 10 50

Bar Iron—Base, in Carloads—Mill price, on dock: common, 1.10 @ 1.20c.; refined, 1.25 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.70c.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, about 1.75. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 11½c.; electrolytic, 11⅛ @ 11¼c.; casting copper, 10⅝ @ 10⅞c.

Pig Tin—For 5 and 10-ton lots, about 13.60 @ 13.70c. f. o. b.

Pig Lead—In carloads, 3.02½ @ 3.05c., f. o. b.

Spelter—In carload lots, New York delivery, 4.10 @ 4.12½c. for ordinary Western brands.

Antimony—Cookson's, 7⅛ @ 7¾c.; Hallett's, 6⅝ @ 6¾c.; Japanese, 6½ @ 6⅝c.

Lard Oil—Prime city, present make, 47c., wholesale.

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Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Foreman boiler maker wants position. A 1 references. Address I. J., AMERICAN MACHINIST.

Wanted—Machinist and sheet iron workers; marine work. Charles Ward, Charleston, W. Va.

Mech. draftsman, shop and drawing room experience, desires to change. Box 120, AM. MACH.

Technical graduate desires position in drafting room or machine shop. Box 139, AM. MACHINIST.

Wanted—Bright active man to take charge of Turret lathe work. Address Box 134, AM. MACH.

Comp. draftsman wants pos., exp. desigr., eng., water tube boilers, gen. mach. Box 143, AM. MACH.

Mechanical draftsman, with shop and drawing-room experience, wants pos. Box 141, AM. MACH.

Planer hand wants position; accustomed to large or small wk.; rapid, accurate. Box 145, AM. MACH.

Young man wants to learn toolmaking; age 22. Has 3 years of jobbing machine shop experience. Box 138, AMERICAN MACHINIST.

Wanted—Position as draftsman by young man having had great experience in designing and building special tools. Box 133, AM. MACHINIST.

Wanted—At a technical school, an instructor in machine shop practice. Address, stating age, experience, salary desired, etc., Box 127, AM. MACH.

Inventor and designer, experienced in drawing office and pat'n shop, thoroughly understands pipe found. wk., wants perm. pos. Box 140, AM. MACH.

(Continued on page 22.)

Manufactures.

The Forest Mining Co., Scranton, Pa., are going to add new mining machinery.

The Marion Coal Co., Scranton, Pa., is intending to put in a new line of mining machinery.

Ammon B. Collier, Elizabethville, Pa., is building a new foundry, brass works and machine shops.

The Iron City Brick & Stone Co., Pittsburgh, Pa., will put in new machinery for manufacturing brick, etc.

The Petersburg & Asylum Railroad, of Petersburg, Va., will be extended and additional equipment will be added.

J. A. Fay & Egan Co., of Cincinnati, Ohio, have received a large order for locomotive and railway-car shop tools for Russia.

The Galena Oil Co., of Franklin, Pa., are building a large lubricating oil refinery at New London, Canada (Province of Ontario).

The Monumental Lathe Co., of Baltimore, Md., has been incorporated and will put in new machinery. John T. Coleman is interested.

The Chambersburg Shoe Mfg. Co., Chambersburg, Pa., are going to increase their plant and put in new machinery for manufacturing shoes.

The Conover Mfg. Co., of 39 Cortlandt street, have moved into their new office on the first floor of the Havemeyer Building, 26 Cortlandt street.

The Lutheran World Pub. Co., York, Pa., have started business, and will put in new ruling machines, also a general line of printing machinery.

L. H. Griffin, Bay City, Mich., will erect new buildings which will be thoroughly equipped with the latest and newest improved laundering machinery.

The Reeves Iron Co., of Canal Dover, Ohio, will erect an immense steel plant at Canal Dover. Capitalists from Cleveland and other points are interested.

The Hartford Steam Boiler Inspection and Insurance Co.'s branch office, 285 Broadway, New York City, has been removed since May 1st to 160 Broadway.

The Bradford, Pa., Electric Street Railway have commenced to break ground for their new street railroad. Everything will be pushed to its utmost capacity for its hasty completion.

Hampton Mfg. Co., Bay City, Mich., will place new machinery in their new factory recently completed; everything in the line of furniture manufacturing machinery will be installed.

The Germania Refining Co., of Rouseville, Pa., are adding a large number of improvements to their refinery, especially bleachers, stills and tanks, so as to be prepared for a larger business.

The Lancaster Milling Co., Lancaster, Pa., have purchased a large building and will at once convert it into a roller mill, and will equip it with all the latest improved machinery for making flour.

The Columbia Corrugating & Mfg. Co., of Niles, O., is going to put in a 100-horse-power steam plant and additional tools for corrugated roofing, spouting, bicycle tubing, drop forgings and machine shop equipment.

The Penberthy Injector Co. on May 12th completed the one hundred thousandth "Penberthy" injector manufactured at their Detroit factory. In honor of this event, the company intend giving their employés a holiday and excursion a little later in the summer.

The citizens of West Newton, Pa., have succeeded in raising the $10,000 required by the United States Radiator Co., now located at Saltsburg, Pa., and the works will be removed at once to West Newton and considerably enlarged.

The Reading Cycle Mfg. Co., Reading, Pa., have just taken out a charter to manufacture bicycles and tricycles; capital $50,000. This company will immediately start to erect a plant and will equip it throughout with the latest improved machinery.

The Peninsular Machine Co., Grand Rapids, Mich., was sold at auction and purchased by C. B. Metz-

Assistant mechanical draftsman wants situation; six years' experience on medium speed, heavy and light engines and power plants; some technical education. Box 128, AMERICAN MACHINIST.

Wanted—Foreman for boiler shop; must be temperate, a good manager and competent to lay out work; about 25 men employed. State experience and wages expected. Box 130, AM. MACHINIST.

Wanted—Superintendent for foundry and machine shop, one conversant with medium to heavy machinery, and preferably with a knowledge of heavy electrical apparatus. Box 136, AM. MACH.

Man 29, technical education, experienced on tools and special machinery, 4 yrs.' shop, 5 yrs.' drawing room, 1 yr. salesman, wants position as salesman, draftsman or assistant. Box 142, AM. MACHINIST.

A 1 toolmaker wants position in small shop; good designer, experienced on experimental and model work; steady work and fair pay all required; satisfaction guaranteed. Box 144, AMER. MACHINIST.

Mechanical engr. (Scotchman) wants situation, exp. in power presses and dies, rock drills and stone-working machinery, also general engineering work; has had charge. Address Box 132, AM. MACHINIST.

Wanted—Situation by a mine M. E. as manager, where mine machinery is built. Have valuable patents relating to rope haulage and mine ventilation to place with my services. Box 121, care AM. MACHINIST.

Wanted—Toolmaker used to small work; must be competent to work from drawings; state age, experience and wages wanted. Shop in vicinity of New York. Address Box 146, care AMERICAN MACHINIST.

Wanted—Position by American technical graduate, 7 yrs.' exp. designing and building tools, engs., cranes and gen. machy.; familiar with shop work; can show good habits, ability, accuracy and attention to business; references. Box 137, AM. MACH.

Wanted—Working foreman for foundry, running 10 men; must be a good molder and understand mixing and melting both iron and brass and be a man of steady habits. State experience and wages expected. Box 129, AMERICAN MACHINIST.

Wanted—A thorough brass moulder; only one who is well up in the modern practice of mixing and casting light and heavy work need apply. State experience and salary expected for steady work. Moran Brothers' Company, Seattle, Wash.

Wanted—By a first-class machinist and d'ftsman, a position with a growing concern, as foreman or assistant superintendent; am now general foreman in engine shop, but wish to change. Best of references given. Box 124, AMERICAN MACHINIST.

Mechanical engineer and draftsman with 18 yrs.' experience on structural iron and steel wrk., steam plants, boiler and gen. construction work, desires engagem't; comp't at design'g, estim'g and cont'g, or would superintend construction, erection or shop work. Address Ajax, care AM. MACHINIST.

Wanted—An assistant superintendent, moderate size Corliss and plain engine-building bus., vicinity New York; New Englander or up to date Westerner pref., who can show costs as testimony ability to turn out good wrk. cheaply; com. absolutely confidential; give experience. Box 135, AM. MACHINIST.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden st., Saginaw, Mich.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

For Sale—5,000 half-worn drills and taps at 1 cent each. Send stamps for samples to J. L. Lucas, Lynn, Mass.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

Machine forgings to order; special facilities for doing good work quick; send for estimates. The Coulter & McKenzie Machine Co., Bridgeport, Ct.

Light and fine machinery a specialty; model and experim'tal wk. strictly confidential; draw'g made and invent's perfected. Howe, 19 Gull st., Buffalo.

For Sale—Second-hand Baker pressure blower for foundry use; direct coupled to upright engine, in first-class condition. Address Ames Iron Works, Oswego, N. Y.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call or get list 17 B. The Garvin Mach. Co., 440 Canal st., N. Y.

For Sale, Cheap—Patterns, drawings, wood cuts, electros and negatives for 16 and 20 inch Pillar shaper, and 20 inch traveling head shaper; design up to date, and many machines already in use; reputation already established. Reason for selling, pressure of other work. Address Box 131, AMERICAN MACHINIST.

VALUABLE BOOKS

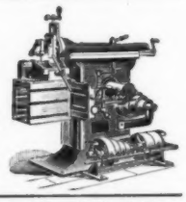
For MACHINISTS, ENGINEERS, ELECTRICIANS, Etc.

Our catalogues of Books, on the above subjects, as well as every other practical subject, sent free to any address.

☞ See our detailed advertisements of special books in recent numbers of AMERICAN MACHINIST.

NORMAN W. HENLEY & CO.,
15 Beekman Street, NEW YORK.

HIGH GRADE Metal-Working
PLANERS AND SHAPERS,



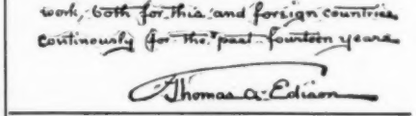
Write for circular and address of nearest agent.
THE OHIO MACHINE TOOL CO.,
600 South Leighton Street,
Kenton, Ohio.

Bargains in New and Second-Hand Machinery.

72 inch, 57 inch, 26 inch and 24 inch Planers, and 36 inch and 56 inch Radial Drills.
48 inch x 18 feet Fitchburg Lathe, modern and triple gear in the head.
4 1-2 inch Pratt & Whitney Cut-off Machine.
7 inch and 12 inch Bement Steam Hammer.
Lathes, Shapers, Drill Presses, Pipe Machines, Bolt Cutters, Steam Hammers, Grinding Machines and General Machinery.
Stock constantly changing. Let me know your wants.
FRANK TOOMEY, 131 North 3d St., Philadelphia, Pa.

POWER PRESSES,
Punches and Shears, Reducing, Forming and Flaring Rolls, Power Hammers and Forging Machines.
DIES AND SPECIAL MACHINERY.
GODFREY J. BREMER
MACHINE CO. Kalamazoo, Mich.
Write for Catalogue "A" and Price-list.

DYER & DRISCOLL,
PATENT SOLICITORS, 36 WALL ST., N. Y.

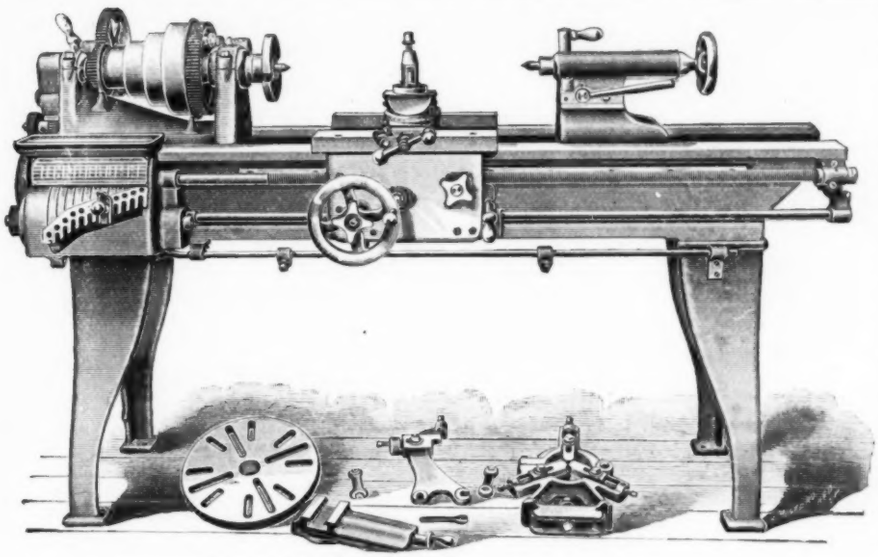

have done all my patent soliciting
work, both for this and foreign countries,
continuously for the past fourteen years.
Thomas A. Edison

RUST ABSOLUTELY PREVENTED
ON MACHINERY, TOOLS AND METALS.
BY
MANNOCITIN
READ
OPINIONS OF LEADING AM. MF'RS.
OTTO GOETZE, U.S. AGT. 114 BROADST. N.Y.

CENTER GRINDERS,
WILLIAM BARKER & CO., Mfrs.,
IRON AND BRASS WORKING MACHINERY,
CINCINNATI, OHIO.

WATER POWER GOVERNED

for electrical and other work, with results equal to the best Corliss engine practice.
Send for Illustrated Catalogue "A."
THE REPLOGLE GOVERNOR WORKS, Akron, O., U. S. A.
MARK A. REPLOGLE,
Chief Engineer.



14 in. x 6 ft. Hendey-Norton Lathe with Improved Automatic Stop.

THIS Lathe COMBINES the LATEST and BEST Improvements. Automatic Stop. It is Simple, Durable, Indispensable. It will AUTOMATICALLY STOP the Carriage in EITHER direction. It is equally efficient whether FEEDING or THREAD-CUTTING. Running up to a shoulder, boring to BOTTOM of holes, or INTERNAL THREAD-CUTTING.

No danger of spoiling either tool or work. It is a safeguard against accidents, in either direction.

Feeds — It has all feeds in daily use with simple movement of lever.

Threads — It has all threads in daily use with simple movement of lever.

Carriage — The carriage reverses in Apron. No slamming of Countershaft. There is no comparison between this Lathe and the old style or common Lathe. Quick work, rapid changes, satisfactory results. BUY THE BEST.

SEND FOR CIRCULAR.

The Hendey Machine Co.

TORRINGTON, CONN.

European Agents:

CHAS. CHURCHILL & CO. (Ltd.),
21 Cross Street, Finsbury, London.

SCHUCHARDT & SCHUTTE,
59 Spandauerstrasse, Berlin.

SOLLER, Basel, Switzerland.

ger, who will continue to manufacture the Garland bicycles. New and valuable improvements have been made, and he has greatly enlarged the plant.

The Buffalo Window Glass Company, Buffalo, N. Y. (Incorporated), will manufacture all kinds of window glass; it is capitalized at $10,000, and the directors for the first year are Charles Judd, Clarence U. Carruth, William Chambers, Charles R. Carruth and Mahlon Shaw.

The Kelly & Jones Co., iron and brass valve manufacturers, of Greensburg, Pa., have let the contract for an extensive addition to their works. When completed 200 additional workmen will be given employment. The new extension will be two-story brick, 120 x 40 feet.

The machinery for the Keystone Axle Co., of Beaver Falls, Pa., is being placed in their new plant and everything will be in operation by July 1st. The company expect to roll 200 axles a day. The axle is toughened by the Rowles process. The company's capitalization is $200,000.

The Harris Automatic Press Co., manufacturers of a new self-feeding printing press at Niles, O., have plans for a new 40 x 120 feet one-story factory, which will be commenced as soon as possible. This company will also make an addition of several new tools and small power plant.

The Sanitarium Canning Co., to be operated by the Battle Creek Medical and Surgical Sanitarium, of Battle Creek, Mich., have leased the plant formerly occupied by the Central Michigan Carriage Co., and are putting in new machinery, and it is expected they will employ 100 hands this season.

In addition to the contracts for blowers and engines for torpedo boats 3, 4 and 5, also the Holland torpedo boat and revenue cutter No. 2, the Buffalo Forge Co., Buffalo, N. Y., have since received from Moran Bros. & Co., Seattle, Wash., similar orders for torpedo boat No. 8. The latter boat requires four blowers with compound engines for each.

During the past week the Davis & Egan Machine Tool Co., Cincinnati, O., have received orders for the following tools: 12-inch drill press for England, one tool room lathe for Paris, France, one hub and cone machine for Stockholm, Sweden, three engine lathes, two Universal milling machines, and one Universal radial drill for Mexico. Their agents in these countries report that the outlook for continuous orders is very good.

Jones & Lamson Machine Co., Springfield, Vt., have recently made shipments of their 2 x 24 flat turret lathes to the following parties: Russian gun factory, Sestroretzk, Russia; M. C. Bullock Mfg. Co., Chicago, Ill.; Chas. Churchill & Co., London, England; Vermont Farm Machine Co., Bellows Falls, Vt.; National Supply Co., Toledo, O.; Eaton, Cole & Burnham Co., Bridgeport, Conn.; Cambria Iron Co., Johnstown, Pa.; M. Koyemann, Dusseldorf, Germany; A. Janssens, Paris, France; W. F. & John Barnes Co., Rockford, Ill.

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New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

McFadden Co., 722 Arch street, Philadelphia, Pa., send us catalog of tools for use by machinists, carpenters, blacksmiths and other tradesmen. The catalog contains 328 pages, and is 4¼ x 6¼ inches.

The American Motor Co., Havemeyer Building, N. Y. City, send us a catalog illustrating and describing single and twin motors made by them. These motors can be used for propelling launches or for stationary purposes. The catalog is 5¾ x 9¼ inches.

The Sawyer Tool Co., Athol, Mass., send us a small catalog giving illustrations and descriptions of rules, gages, squares, levels and kindred tools made by them and used by machinists. The catalog is 4 x 6 inches

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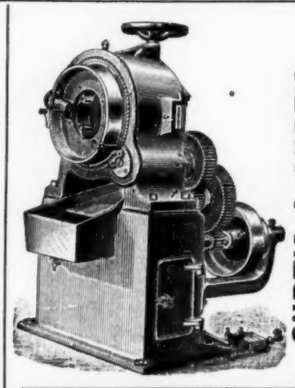

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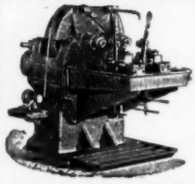

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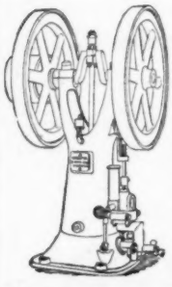

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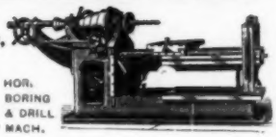
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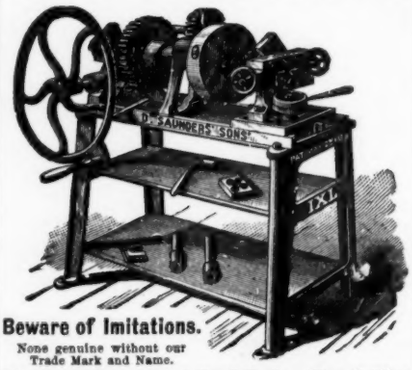

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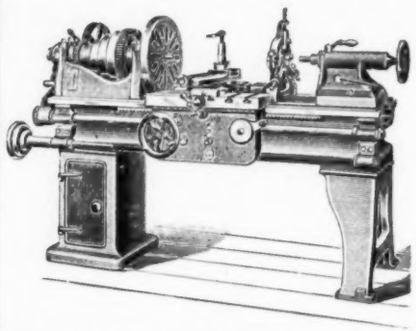

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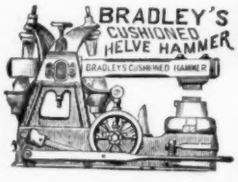

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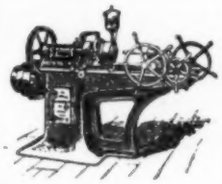

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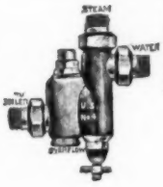

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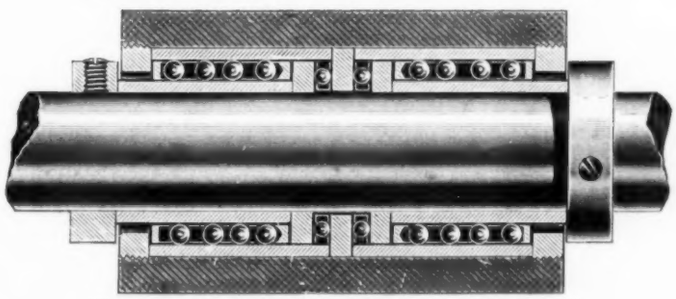

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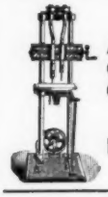

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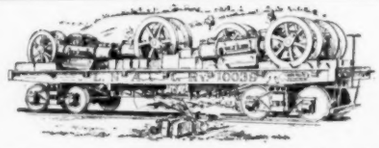

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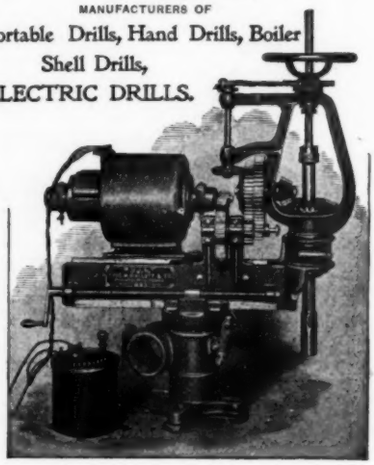

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1 19 in. x 6 ft., Fifield Eng. Lathe, heavy.
1 20 in. x 11 ft., L. & M. Eng. Lathe with Shafting tool rest.
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1 28 in. x 12 ft., Wood & Light Eng. Lathe, comp. rest.
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1 28 in. x 28 in. x 8 ft., Gay & Silver.
1 30 in. x 30 in. x 8 ft., Smith & Silk.
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1 32 in. x 10 ft., Open Side Planer, braced arm.
1 36 in. x 36 in. x 9 ft., New Haven.
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1 36 in. Gap Drill, power feed.
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2 3-spindle Sensitive, adjule.
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1 12 in. Traveling Head.
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1 No. 30, Bliss, single action.

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1 C. & C. Electric Motor, 50 K. W. Generator.
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Lathes (see also Turret Lathes).
Barnes Co., W. F. & John, Rockford, Ill.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dietz, Schumacher & Boye, Cincinnati, O.
Fifield Tool Co., Lowell, Mass.
Fish Machine Works, H. C., Worcester, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Gould & Eberhardt, Newark, N. J.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
McCabe, J. J., New York.
McFadden Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Sebastian Lathe Co., Cincinnati, O.
Sebastian-May Co., Sidney, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark John, Boston, Mass.
Wagner & Andreas, Leipzig, Germany.

Machinists' Tools and Supplies.
Frasse Co., T. H. E., New York.
Machinists' Supply Co., Chicago.
Montgomery & Co., New York.
Sawyer Tool Co., Athol, Mass.
Standard Tool Co., Athol, Mass.
Starrett Co., The L. S., Athol, Mass.

Milling Attachment.
Adams Co., The, Dubuque, Iowa

Milling Cutters.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Erlandsen, J. New York.
Garvin Machine Co. New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Reinecker, J. E., Chemnitz Gablenz, Germany.
Starrett, L. S., Athol, Mass.

Milling Machines.
Bliss Co., E. W., Brooklyn, N. Y.
Brainard Milling Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Forbes & Co., W. D., Hoboken, N. J.
Garvin Machine Co., New York.
Ingersoll Milling Machine Co., Rockford, Ill.
Kempsmith Machine Tool Co., Milwaukee, Wis.
Leland & Faulconer Mfg. Co., Detroit, Mich.
McCabe, J. J., New York.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

Models.
Park Mfg. Co., The, New Haven, Conn.

Motors, Electric.
Dallett & Co., Thos. H., Philadelphia, Pa.
General Electric Co., New York.
Roth Bros. & Co., Chicago, Ill.

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Abbott, Wheelock & Co., Boston, Mass.

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Hine & Robertson Co., New York.

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Phosphor Bronze Smelting Co., Ltd., Philadelphia, Pa.

Pipe, Bent.
National Pipe Bending Co., New Haven, Conn.

Pipe Coverings.
Johns Mfg. Co., H. W., New York.

Continued on page 30.

BUYERS' FINDING LIST—Continued.

Pipe Cutting and Threading Machines.
Armstrong Mfg. Co., The, Bridgeport, Conn
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis, Bridgeport, Conn.
Detrick & Harvey Machine Co., Baltimore, Md.
National Machinery Co., Tiffin, O.
Saunders' Sons, D., Yonkers, N. Y.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Planers.
Betts Machine Co., Wilmington, Del.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Detrick & Harvey Machine Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Garvin Machine Co., New York.
Gray Co., G. A., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co, New York.
Ohio Machine Tool Co., The, Kenton, O.
Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Wilson, W. A., Rochester, N. Y.

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Builders Iron Foundry, Providence, R. I.

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Bliss Co., E. W., Brooklyn, N. Y.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Ferracute Machine Co. Bridgeton, N. J.
Mossberg Mfg. Co., Attleboro, Mass.
Stiles & Fladd Press Co., Watertown, N. Y.
Toledo Machine & Tool Co., The, Toledo, O.

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Hine & Robertson Co., New York.

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Deane Steam Pump Co., Holyoke, Mass.
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Mason Regulator Co., Boston, Mass.
Wetherill Machine Co., James P., Chester, Pa.

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Ratchet Drills.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.

Raw Hide.
New Process Raw Hide Co., Syracuse, N. Y.

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Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
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Taylor-Rice Engineering Co., Gloucester City, N. J.
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Rock Drills.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

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Mossberg Mfg. Co., Attleboro, Mass.

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Coffin & Leighton, Syracuse, N. Y.
Darling, Brown & Sharpe, Providence, R. I
Sawyer Tool Co., Athol, Mass.
Standard Tool Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.
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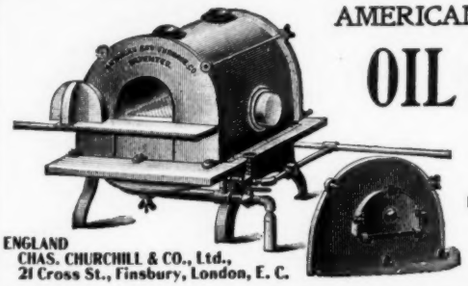
Flather & Co., Nashua, N. H.
McFadden Co., Philadelphia, Pa.
Worcester Machine Screw Co., Worcester, Mass.

Screw Plates.
Machinists' Supply Co., Chicago, Ill.
Reece, Edw. J., Greenfield, Mass.
Wells Bros., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Screws.
Cleveland Machine Screw Co., Cleveland, O.
Worcester Machine Screw Co., Worcester, Mass.

(Continued on page 31.)



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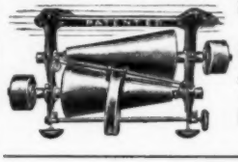

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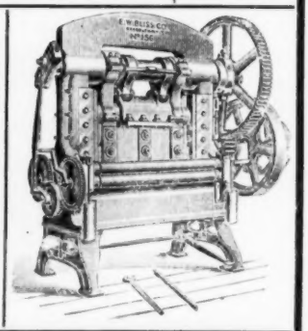

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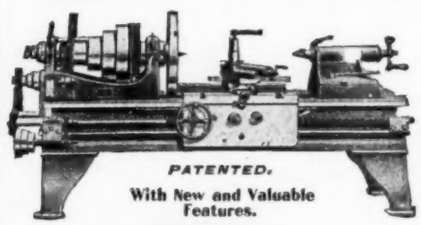

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Fitchburg Machine Works, Fitchburg, Mass.
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Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Ohio Machine Tool Co., The, Kenton, O.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Shears, Circular.
Bethlehem Fdy. & Machine Co., South Bethlehem, Pa.

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Betts Machine Co., Wilmington, Del.
Niles Tool Works Co., Hamilton, O.
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Elliott Chemical Works, Newton, Mass.

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Bremer Machine Co., G. J., Kalamazoo, Mich.
Toledo Machine & Tool Co., The, Toledo, O.
Park Mfg. Co., The, New Haven, Conn.

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Sackmann, F. A., Cleveland, O.

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Hine & Robertson Co., New York.

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Abbott, Wheelock & Co., Boston, Mass.
Crescent Steel Co., Pittsburgh, Pa.
Johnson Co., The, Johnstown, Pa.
Jones & Co., B. M., Boston, Mass.
McFadden Co., Philadelphia, Pa.

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McFadden Co., Philadelphia, Pa.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Webster & Perks Machine Tool Co., Springfield, O.

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Gould & Eberhardt, Newark, N. J.

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Coburn Trolley Track Mfg. Co., Holyoke, Mass.

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Almond, T. R., Brooklyn, N. Y.

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Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
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Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Warner & Swasey, Cleveland, O.

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McFadden Co., Philadelphia, Pa.
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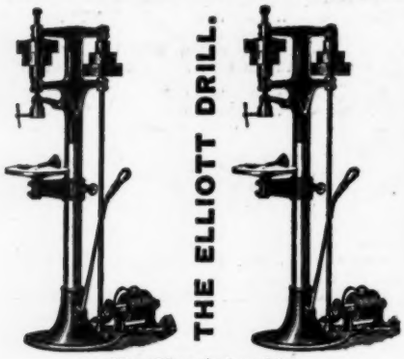

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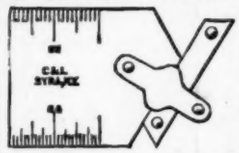

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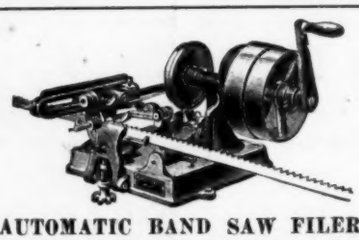

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